SER. II, VOL. 20 *February 1958* NO. 4

TRANSACTIONS
OF
THE NEW YORK ACADEMY OF SCIENCES

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Transactions of The New York Academy of Sciences, Series II, Volume 20, No. 4, February 1958

Entered as second-class matter December 28, 1954, at the post office at New York, N. Y., under the act of August 24, 1912. This publication is distributed to members and is published monthly from November to June, inclusive, by The New York Academy of Sciences, 2 East Sixty-third Street, New York 21, N. Y.

Executive Director: EUNICE THOMAS MINER

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Ser. 2
V. 20
no. 4

SECTION OF GEOLOGY AND MINERALOGY

GEOMORPHOLOGY AND GEOLOGY*

By Sheldon Judson

Department of Geology, Princeton University, Princeton, N. J.

General Statement

In this brief discussion I hope to show that the development of geomorphology in the United States has led to its inclusion in the general field of geology. This will lead us to an examination of the general framework of the subject of geology and the manner in which geomorphology fits into this framework. This in turn will suggest a model for geomorphology. Finally we may inquire what we may learn as geomorphologists from an analysis of this model.

Geomorphology in the United States

Geomorphology in the United States received its great initial impetus from William Morris Davis. In a series of papers appearing between the late 1880s and the early 1900s Davis set the stage for the rapid growth and wide acceptance of the subject, and his mark is still upon the subject today.

Despite Davis's importance in the development of geomorphology, obviously the subject did not spring full-blown from his mind. References in his written work (Davis, 1889, 1890, 1902) reveal the strong debt he owed to Powell for his concept of the idea of base level (see also Chamberlin, 1894). Furthermore, I suspect that Powell and his co-workers foreshadowed the Davisian concept of the geographic cycle and the peneplain. Another important factor, I think, influenced Davis, although I have not yet been able to document it. This is the general concept of evolution. In 1859 Darwin had expounded the first convincing mechanism for organic evolution. The general idea of evolution was one of the most exciting and pervading concepts of the latter part of the Nineteenth Century. The evolution of landscape, the geographic cycle of Davis, bears the imprint of Darwinism. Davis enlivened the doctrine of the inorganic development of land forms with the anthropomorphic terms of "youth, maturity, and old age." One wonders how much appeal the geographic cycle would have had if Davis had used "Stage 1, Stage 2, and Stage 3" instead. As Russell (1904) said, geomorphology was "vivified by evolution."

*This paper, illustrated with lantern slides, was presented at a meeting of the Section on January 6, 1958.

W. M. Davis always considered himself a geographer and, in truth, much of his work was done in the field of physical geography. Nevertheless, he was one of the founding members of The Geological Society of America and, from the beginning, the geologic profession flocked to the Davisian standard. As Bryan wrote (1941, p. 4), the geologists of the day considered that "the study of the origin of land forms was a worthy objective, and the use of physiographic methods in the study of geologic events, not otherwise recorded in the rocks, was an additional tool in the hands of the skillful geologists." To them "Land form = process + structure + stage" was a phase of geology.

In his monograph on the development of geography Hartshorne (1939, pp. 88 and 424) infers that geomorphology in America has been largely the domain of the geographer. There is not much concrete evidence to this effect. Most geomorphic studies currently appear in the geologic journals; when they appear in geographic publications they are often the work of members of departments of geology. In fact, about 130 of the slightly more than 200 colleges and universities offering undergraduate degrees in geology teach one or more courses in geomorphology. Furthermore, approximately 300 members and fellows of The Geological Society of America are affiliated with the recently formed Geomorphological Group of the society.

Seventy years after Davis, the geographer, wrote his classic paper on the "Rivers and Valleys of Pennsylvania," geomorphology finds itself firmly established in the American college department of geology and, for better or for worse, the subject seems there to stay for some time to come. We can agree with Bryan (1941, p. 5) that the study of land forms is now part of the "mother science of geology," a thought reiterated by Horberg (1952, p. 187) in the statement that geomorphology strikes close to the "common ground of all geology."

Geomorphology and Geology

The geologist is not prone to self-analysis, to the search for the nature and meaning of his subject, to the construction of conceptual models.* Nevertheless, we have decided that the geomorphologist is housed in geology. Perhaps, if we consider ourselves geomorphologists, we should examine our living quarters. Therefore, at the risk of being both unfashionable and impertinent, let us examine the nature of geology and construct a general framework for the subject.

We define a science as an organized body of knowledge, and we understand geology to be an organized body of knowledge about the earth, particularly with reference to its composition and structure and its physical and biological history through time. If we examine the nature of

*The exceptions to this are to be found in the post-World War II discussions on the education of the geologist as reported in the interim proceedings of The Geological Society of America in 1946 and 1948.

geology more closely we shall see that the subject can be viewed as composed of three separate parts, namely: (1) the systematics; (2) geography; and (3) time (history). These are shown in FIGURE 1 as a first approximation of a model for the structure of geology.

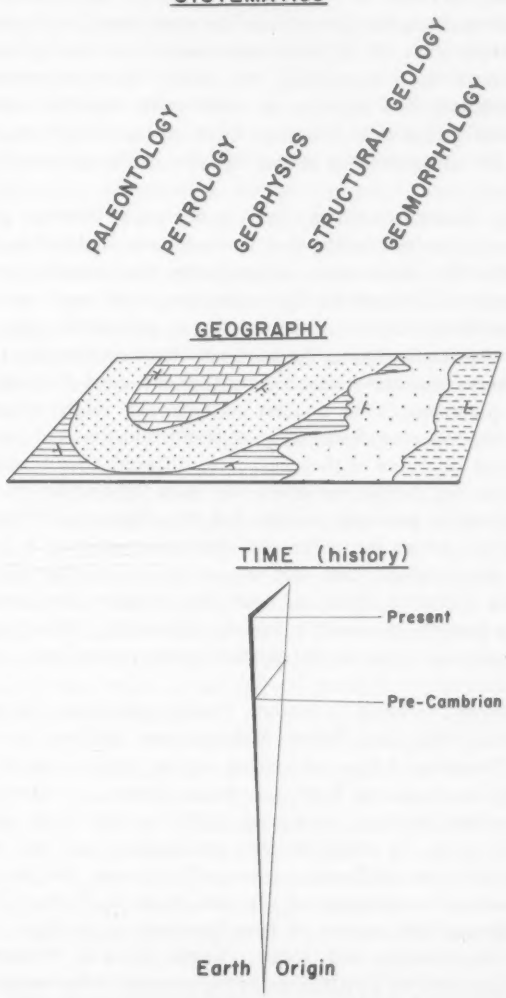

FIGURE 1. The major elements of geology may be considered as systematics, geography, and time (history).

Systematics. Systematics refer to classification. In geology we have any number of systematics. We classify minerals on the basis of their crystal systems, or their chemical compositions, or the arrangement of their atoms, or the nature of such physical characteristics as hardness, cleavage, and streak. The pigeonholes of paleontology are as familiar and necessary as those of mineralogy. Petrology, geophysics, structural geology, and geomorphology all can be considered as systematics of geology. We can view all of these subsciences as ways of studying and ordering certain data concerning the earth. Outside geology we can classify chemistry and physics as systematic sciences, and much of biology comes within this category. Each of these three sciences contributes to the effectiveness of one or more of the systematics that we use in geology.

Geography. There has always been a confusion between geology and geography, a misunderstanding that has not been confined to the general public. Within the professions of geography and geology there are few workers who are flattered by this confusion, and most are adamant in claiming that their work is either geologic or geographic, depending upon their professional allegiance. We need not become embroiled in profitless arguments here. However, we can say that the most distinctive characteristic of geography is its concern with spatial relationships. Thus, a geographer may map the distribution of world climates and perhaps determine the areal relations of these climatic differences with soil types, or industries, or population densities. We must agree that this is a geographic and not a geologic pursuit, but the relation of things in space is the concern of both the geographer and the geologist. A geologic map is, among other things, one that shows the geographic distribution of rocks at the earth's surface and that also suggests the arrangement of these rocks beneath the earth's surface. Certainly, paleogeographic and paleogeologic maps also depict spatial relationships and, as such, are geographic.

Time (history). Geology is history. Perhaps more than any other single characteristic, the time factor distinguishes geology from the other sciences. The idea of time, of history, as an integral part of geology is not new. We can quote the Scotsman, James Hutton, so often cited as the father of modern geology, as saying (1795, p. 564) "the natural operations of this globe, by which the size and shape of our land are changed, are so slow as to be altogether imperceptible to men who are employed in pursuing various occupations of life and literature." Since Hutton's day the estimates of the amount of time involved in geologic history have increased tremendously and, today, various lines of evidence converge on an estimate of 4 to 5 billion years for the age of the earth. Apparently, also, we have made some progress in educating the nongeologist to the immensity of this period. This is the inference of Knopf (1949) who

writes: "If I were asked as a geologist what is the single greatest contribution of the science of geology to modern civilized thought, the answer would be the realization of the immense length of time. So vast is the span of time recorded in the history of the earth that it is generally distinguished from the more modest kinds of time by being called 'geologic time.'"

It is time that gives perspective to the systematic and geographic aspects of geology, and it is time or history that distinguishes geology from sciences such as chemistry and physics, which rely primarily upon classification of things and objects. It is time that distinguishes geology from most geographic investigations, based largely as they are on the relation of things in space. Probably the science that most closely resembles geology in its nature is astronomy, which deals, not only with systematics, but with space (geography) and also with time.

These three elements – systematics, geography, and time – can be combined in a single diagram as shown in FIGURE 2.* The two geologic maps represent spatial relationships (geography) of the present and of some past time. Paleontology, petrology, and other systematics can be considered independently of these maps, or they can be used in their construction. In another context the systematics are arranged in the vertical plane (time) and may be treated historically. In this sense paleontology ceases to be a study in taxonomy alone and changes to the study of organic evolution.

We shall see later that this model can be applied to geomorphology. However, it is worth pointing out parenthetically that the model explains the relation of the various geologic pursuits to each other. For instance we often look upon the mineralogist and the paleontologist as irreconcilable. In fact, in many institutions of higher learning, we find them segregated into separate departments. Yet the model of FIGURE 2 demonstrates that they are not strange bedfellows, and each of them is involved in a systematic that bears on the general problem of the earth's history, structure, and composition.

Let us return now to our subject of geomorphology. Thus far we have maintained that geomorphology is a part of geology; we have defined geology; and we have examined the general framework of geology. We may now ask: What are the activities of the geomorphologist and how do they fit into the general framework of geology?

Primarily, the description of land forms and the study of their distribution have fallen largely to the geomorphologist. In this country Fenneman's two-volume work (1931, 1938) summarized this particular phase of

*The ideas behind this diagram are not new; it is very similar to that employed by Sarton (1936; Figure 6) to illustrate problems faced in the study of the history of science. It is also similar to a diagram used by Hartshorne (1939; Figure 1) to show the organization of geography, except that Hartshorne does not include the dimension of time. The three elements involved are the same as those discussed by Kant in his analysis of organized knowledge, although I know of no attempt by him to show the relations graphically.

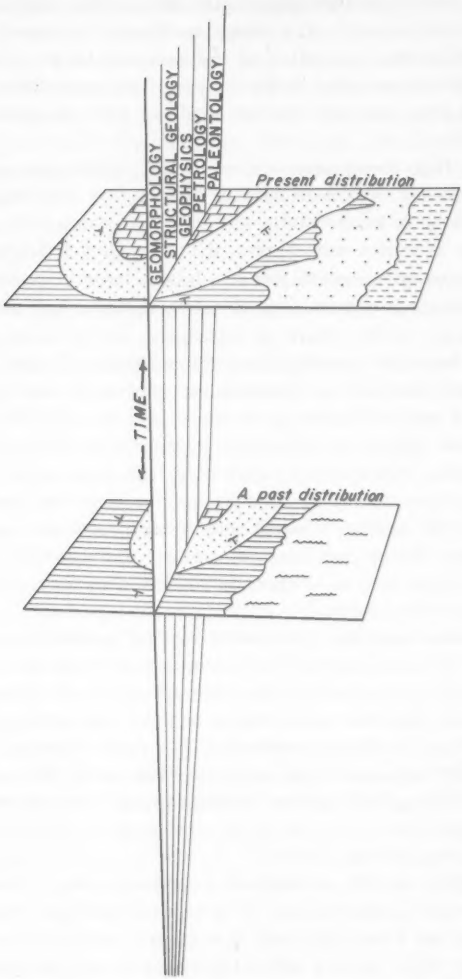

FIGURE 2. Systematics, geography, and time combine to form this model of geology.

geomorphology for the United States. Other land areas are also known to a greater or lesser degree, and now attention turns to the ocean basins, where recent workers have begun to classify various provinces of the ocean floor (Hess, 1948, Dietz, 1954, and Heezen and Tharp, 1956, to name but a few).

In addition to the description and distribution of land forms, the geomorphologist has been, and continues to be, interested in the processes that create land forms. Davis's concern with the activity of running water and the land forms that result are familiar to us all. Today we continue to study process in various ways. For instance, Horton (1945), Strahler (1950), and Leopold and Maddock (1953) have instituted more quantitative analyses of process than have been attempted previously.

Finally, we can point out that somewhere in the work of every investigator who calls himself a geomorphologist there is the consideration of time. Perhaps it is in the history of a particular land form, sometimes in a regional landscape. In most instances (but not all) the geomorphologist operates within the historical period of the Pleistocene. In fact, as Horberg (1952) points out, the glacial geologist, the Pleistocene geologist, and the geomorphologist are virtually indistinguishable, one from another.

Each of these three activities of the geomorphologist fits with one of the three major elements that we found to compose the subject of geology. Thus, the description and distribution of land forms is geographic, the study of process is the study of systematics, and the study of the genesis of land forms is history. Couple these similarities with the fact that both the geomorphologist and the geologist are concerned with the earth and it is not surprising that geomorphology is an inherent part of geology.

The Structure of Geomorphology

If we take the preceding discussion as a point of departure, it appears proper that the structure or the general framework of geomorphology should be very similar to that proposed for geology in FIGURE 2. Adapting the model for geology to geomorphology, we have the relations shown in FIGURE 3.

In FIGURE 3 the two landscape sketches represent a present-day geography and the geography of some past time. Time is represented by the vertical plane cutting these two landscapes. The systematics can be applied to the geographic planes or to history, or can be considered by themselves. The model accommodates the activities of the geomorphologist. For instance, it can embrace a quantitative analysis of process as easily as a description of the distribution of land forms or a study of the genesis of modern land forms or the reconstruction of a past landscape.

This is all very well, but we must now ask whether we can learn anything new from our model. Does it do anything other than provide a convenient tent to cover the subject of geomorphology? Does it suggest any new approaches or new emphases? At this point a few observations are valid.

First we shall consider the geographic aspects of the subject. We have a number of studies of past geographies, but when we stop to ana-

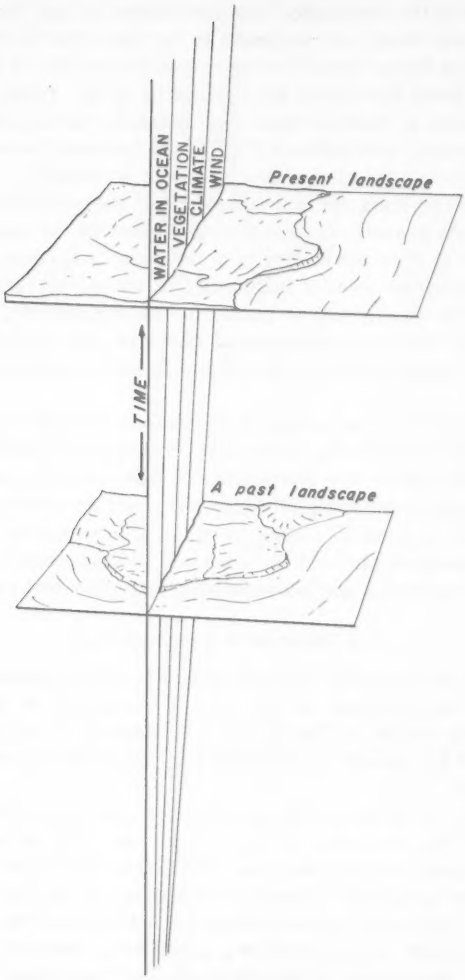

FIGURE 3. This model for geomorphology combines the same basic elements as does that for the model of geology in FIGURE 2.

lyze the subject there remains much to be done. Even for the Pleistocene epoch, where the geomorphologist is most active, geographic compilations are scarce. Thus, it is now time to compile the paleontological data, both plant and animal, to see what they can tell us of conditions in what is now the United States at various phases in the Pleistocene epoch; this

material can be combined with data from changing sea levels, frost soils, wind deposits, ice margins, stream regimes, and limnologic data to give us much clearer pictures of the Pleistocene environments. In this respect we are very far behind the Europeans. Although their data are more complete than ours, we have sufficient information to make an intelligent start on a synthesis. Incidentally, most of the European compilations have been made by workers who consider themselves geographers.

Farther back in geologic time reconstructions of paleogeographies are also possible. Simplified paleogeographic maps are included in all elementary textbooks on historical geology, and the paleogeographic maps of the Jurassic period recently issued by the United States Geological Survey (McKee, 1956) are impressive. However, the point I desire to make here is that the geomorphologist could add to the interpretations of paleogeography. It is also a field in which he has not been too active.

Looking again at FIGURE 3, you will note that I have included four systematics in the diagram, including water in the ocean. Suppose we were to follow this one systematic through time. For instance, investigators are fairly well agreed that the total amount of water available in the hydrologic cycle has increased through time with the addition of juvenile water to the system. As waters in the ocean basins have increased, what has this meant in the evolution of these basins? On a shorter range we know that water has been added to and subtracted from the oceans by the fluctuations of glacial ice in the Pleistocene age, and it is common knowledge that this has altered the shore lines of the world. We know that these fluctuations of sea level may also produce isostatic adjustments of the ocean basins; but may it not also effect a change in level by an elastic adjustment, particularly along the alternately flooded and exposed coastal regions? If this is possible, may this not be another fact that could be useful in explaining some of the enigmas of Pleistocene marine levels in areas beyond the effect of warping by the weight of glacier ice?

Another question presents itself. Is it not true that tidal intensities and frequencies have changed through the earth's history, decreasing as we approached the present? Over a long period of time the earth and the moon have been moving apart and the length of the day has been lengthening. Does this not mean, then, that at some time in the past the tides as a geologic process were much more important than they are today? Also would this not be a factor to consider in the interpretation of the earth's ancient records?

We can insert other systematics into our model. One is the changing nature of the plant cover with time. What does this mean in relation to erosion, ancient land forms, and sedimentation? Introduction of grasses in the Tertiary period may be expressed in ways other than a change in animal dentition.

Another observation comes to mind. We have very few studies of the systematics of geomorphology through time. There is, of course, Brooks's *Climate Through the Ages* (1948). What about some of the others? We lack a study of the role of wind action from the present to ancient times. We have Bagnold's work on the modern process of wind action (1941), as well as numerous other shorter studies of the process. Why not study wind action through geologic time? Perhaps we can explain all past wind phenomena on the basis of our knowledge of present process: that is, by applying the principle of uniformitarianism. If we can do this, we shall certainly have added to our understanding of the earth's history. On the other hand, we might also find some things difficult to explain by using the formula "the present is the key to the past." If so, this may point to inadequacies in our present knowledge of observable process, or it may mean that the process itself has changed with time and that, in some instances, uniformitarianism may not be the open sesame that it usually is. The same general observation can be made for such other processes as weathering, soil production, and mass movements.

Summary

For all practical purposes geomorphology in the United States today is part of the subject of geology. It shares with geology the same conceptual model, a pattern based on the study of systematics, of geography, and of history. An examination of this model suggests questions that may lead us to new emphases, new approaches, new facts, and new knowledge.

Acknowledgments

In the preparation of this paper I have been aided by helpful discussions with Saul Aronow, Lamar State College, Beaumont, Texas; David Smith, Dartmouth College, Hanover, N.H.; and Paul MacClintock, V.E. Gwinn, and D.M. Pinckney, Princeton University, Princeton, N.J.

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SECTION OF PHYSICS AND CHEMISTRY

THE NUCLEOPHILIC CENTER IN AMIDES*

By David Davidson

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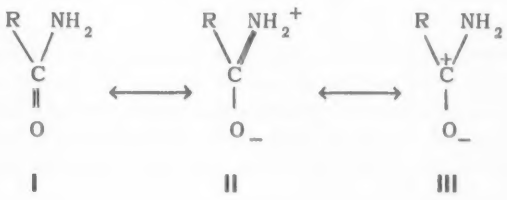
Amides may be represented as resonance hybrids of three structures:



I II III

The conventional structure I indicates that an electrophilic carbonyl group is attached to a nucleophilic amino group. In structure II the amino and carbonyl groups have interacted so that the oxygen atom is the nucleophilic center. Structure III represents the carbonyl carbon atom as the electrophilic center and permits either the oxygen atom or the nitrogen atom to be the seat of nucleophilicity.

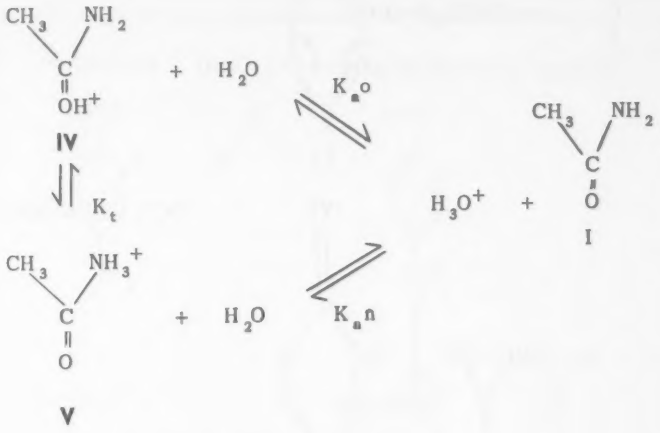
Examination of the chemical behavior of amides reveals that the oxygen atom is generally the center of attack by electrophilic reagents such as acids, acid anhydrides, acid chlorides, the amides themselves, and alkyl halides. This is not always readily apparent from the nature of the products obtained.

Acids

As far as the basicity of amides is concerned, it has been calculated[1] that the basicity of the nitrogen atom in acetamide is only one millionth of that of the substance itself. This means that the conjugate acid of

*This paper was presented at a meeting of the Section on January 7, 1958.

acetamide is a mixture of tautomers with a tautomeric constant, $K_t = [V]/[IV] = 10^{-6}$.



Acid Anhydrides

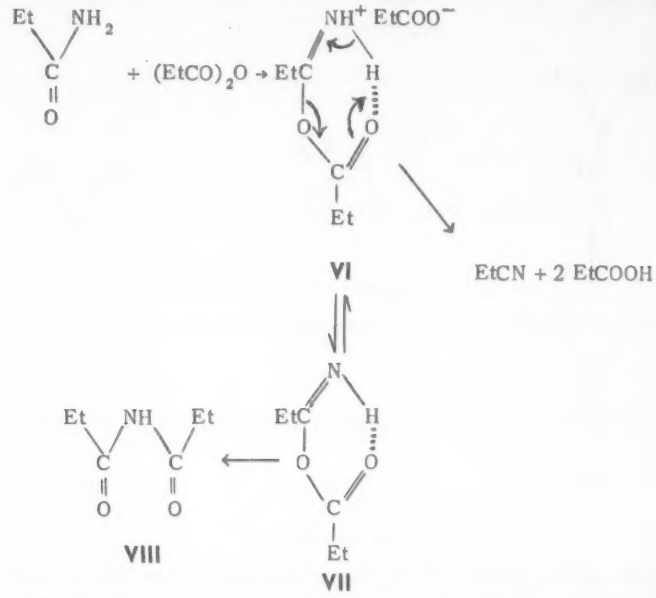
Propionamide reacts with propionic anhydride at the boiling point of the mixture[2] to give a 23 per cent yield of dipropionamide, $(EtCO)_2NH$. The major product of the reaction is propionitrile, the formation of which has been dismissed as being due to dehydration. The inclusion of a trace of propionyl chloride diminishes the yield of imide to 14 per cent. As larger amounts of acid chloride are included the yield of imide rises and at one molecular proportion the yield of imide becomes 74 per cent. While dipropionamide undergoes decomposition to nitrile and acid at 250° C., the rate of this reaction is too low at 150° C. to account for the high yield of nitrile obtained in these experiments. One must assume, therefore, that the imide and nitrile emerge from concurrent rather than from successive reactions.

Accordingly, it is desirable to propose an intermediate that can give rise to both nitrile and imide. This has been found in the O-acyl derivative of the amide. The resulting isoimidinium carboxylate (VI) may undergo a six-center reaction to form nitrile and acid. It may also undergo protolysis to the isoimide (VII). The latter contains an anhydride grouping, as well as an acylatable nitrogen atom; hence the isoimide rearranges to the imide (VIII).

When propionyl chloride is added to the reaction mixture, hydrogen chloride is formed by the reaction:

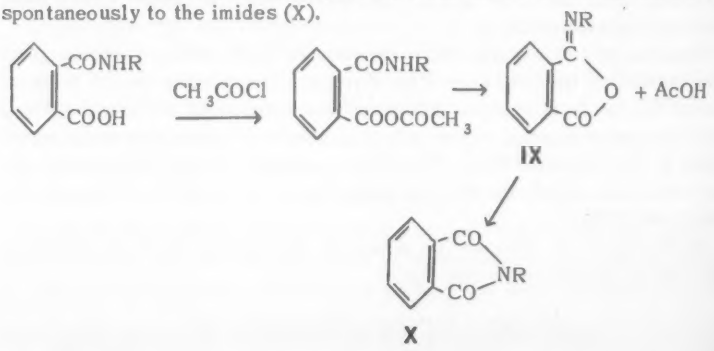
$$EtCOCl + EtCOOH = (EtCO)_2O + HCl$$

The acid thus formed suppresses the dissociation of the isoimidinium

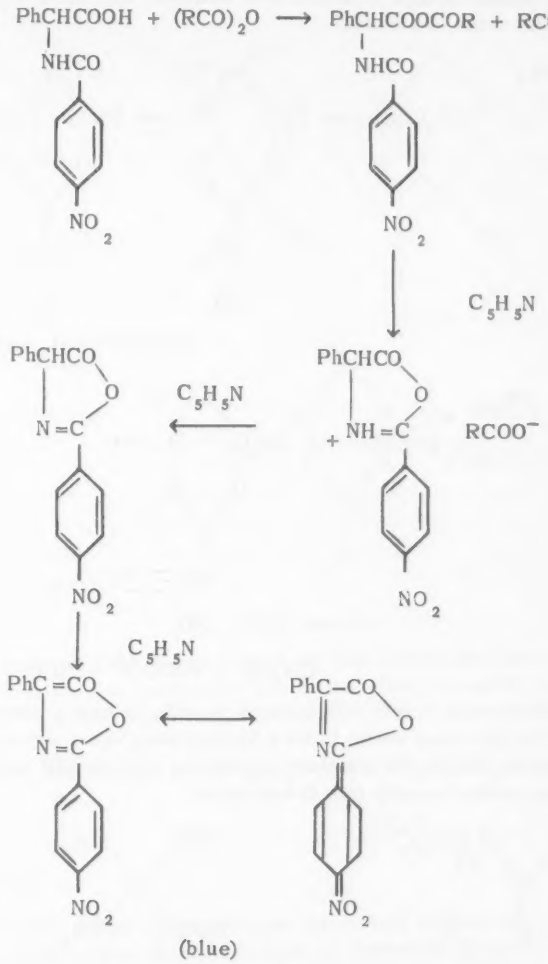


ion in VI and hence favors the six-center reaction leading to nitrile. When larger amounts of propionyl chloride are employed and more acid catalyst is available, a new effect appears; that is, acyl catalysis. A proton adds to the carbonyl oxygen atom of VI. This increases the reactivity of the carbonyl group and also the acidity of the $=NH_2^+$ group. This results in a greatly increased rate of rearrangement to imide.

When the anhydride and amide groups are favorably situated with respect to each other in the same molecule, the isoimides may actually be isolated.[3,4] These substances (IX) are weak bases, and they rearrange spontaneously to the imides (X).



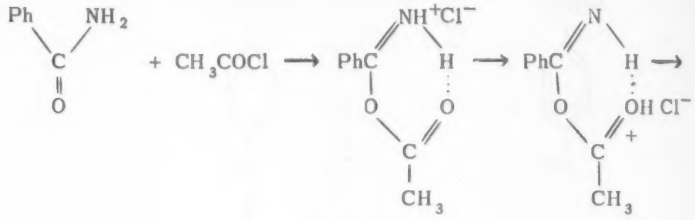
A case in which an O-acyl derivative is "frozen" in a cyclic structure concerns the well-known cyclization of α-acylamino acids to azlactones.[5] The example that follows is a useful reaction for the detection of acyclic anhydrides since the anion formed is blue in pyridine solution.



Acid Chlorides

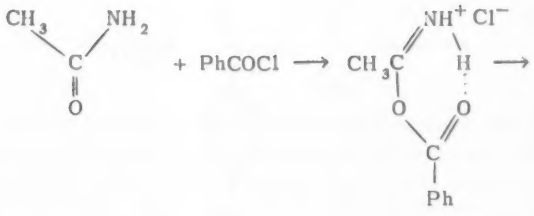
The action of acetyl chloride on benzamide[6] gives a good yield of N-acetylbenzamide and no benzonitrile, while the action of benzoyl chloride on acetamide yields only acetonitrile and no imide. The reason for this

difference in behavior may be seen in structures XI and XII. In XI the inductive effects of the phenyl and methyl groups promote the transfer of a proton from the nitrogen atom to the carbonyl oxygen atom; hence the rearrangement to imide is facilitated. In XII the reversed positions of the phenyl and methyl groups stabilize this structure and permit the six-center reaction alone to proceed.



XI

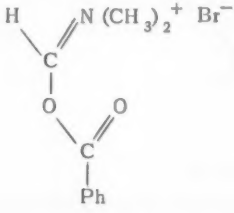
$$PhCONHCOCH_3 + HCl$$



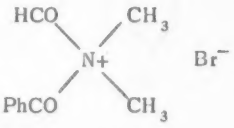
XII

$$CH_3CN + PhCOOH + HCl$$

Dimethylformamide reacts with benzoyl bromide to form a strong electrolyte.[7] This has been shown to be a benzoylating agent and not a formylating agent. Hence, its structure is given by formula XIII rather than XIV, and the product results from O-acylation.



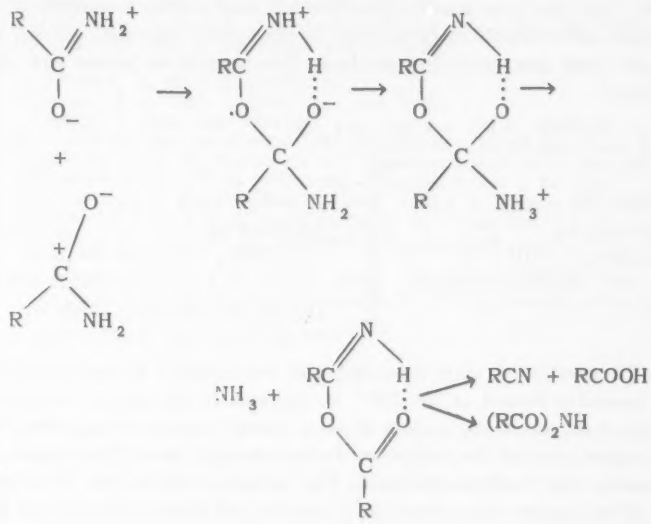
XIII



XIV

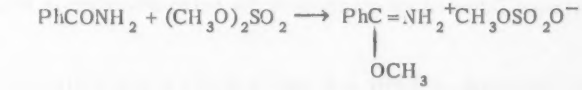
Amides

The pyrolysis of amides yields mainly nitrile, acid, and ammonia, with a minor amount of imide (self-acylation).[8] Hydrogen chloride increases the yield of imide.[9,10] The following course of reaction has been suggested.[8]



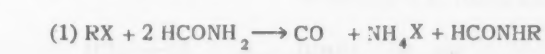
Alkyl Halides

As early as 1904 it was pointed out that benzamide reacts with methyl sulfate to form an imidoester, the methosulfate of methyl imidobenzoate (XV).[11] A similar reaction occurs with



XV

acetanilide. Ethyl iodide behaves as methyl sulfate does.[12] A recent study of the action of alkyl halides on formamide[13] at 150° C. showed that two types of reaction occur:



Both types of behavior may be accounted for by an imidoester hydrohalide intermediate. In the first case the intermediate may rearrange in a well-known fashion [14] to N-alkylformamide and hydrogen halide. In the second, it may decompose in an equally well-known fashion to hydrogen cyanide, hydrogen halide, and alcohol. In the first case the hydrogen halide reacts with two molecules of formamide to form ammonium halide and diformamide, which, like the corresponding anhydride, lose carbon monoxide to regenerate one molecule of formamide. In the second reaction, alcohol and halogen acid react with formamide to form ammonium halide and alkyl formate.

$$HCONH_2 + RX \longrightarrow HC(OR)=NH_2^+X^-$$

$$HCN + HX + ROH \text{ followed by } HCONH_2 + ROH + HX \longrightarrow HCOOR + NH_4X$$

$$HCONHR + HX \text{ followed by } 2\,HCONH_2 + HX \longrightarrow NH_4X + (HCO)_2NH$$

$$(HCO)_2NH \longrightarrow CO + HCONH_2$$

In the reaction of alkyl bromides with acetamide [15] N-alkylacetamides are generally formed at 200-220° C. Apparently the higher temperature employed increases the number of alkyl groups capable of migrating from the oxygen atom of the imidoester to the nitrogen atom. Diacetamide accompanies the N-alkylacetamides. The reverse reaction, the decomposition of imidoester hydrochlorides to amides and alkyl chlorides has been observed in several cases. [16,17,18]

$$RC(OR')=NH_2^+Cl^- \longrightarrow RCONH_2 + R'Cl$$

The action of sodium hydroxide on α-bromo- α, α-dialkylacetamides [19] that yields ketones and sodium cyanide is readily interpreted by means of O-alkylation followed by scission of the imido-α-lactone to α-hydroxynitrile:

$$R_2CBrCONH_2 + NaOH \longrightarrow NaBr + H_2O + R_2C(-C(=O)-)=NH \longrightarrow$$

$$R_2C(OH)CN \xrightarrow{+\,NaOH} H_2O + NaCN + R_2CO$$

Finally, the action of chloroacetone on acetamide [20] yields 2,4-dimethyloxazole as a result of O-alkylation:

$$CH_3CO(NH_2) + ClCH_2COCH_3 \longrightarrow CH_3C(=N-)O-CH=CCH_3$$

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*SECTION OF MATHEMATICS AND ENGINEERING**

THE MOMENT-DISTRIBUTION METHOD FOR BEAMS ON AN ELASTIC FOUNDATION**

By M. G. Salvadori

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Introduction

The moment-distribution method is popular among engineers because of its simplicity and its rapid convergence. The extension of this method to continuous beams (or frames) on rigid end supports and on a continuous Winkler foundation allows the easy solution of problems on foundation beams, piping systems, and closely ribbed shells.

Fixed-End Moments

The fixed-end moments due to a uniform load q for a beam of span L on an elastic foundation are given in Hetenyi,[1] p. 63.

$$\bar{M} = q\,\frac{L^2}{12}\cdot\bar{m}_\gamma \tag{1}$$

where

$$\bar{m}_\gamma = \frac{6}{\gamma^2}\,\frac{S(\gamma)-s(\gamma)}{S(\gamma)+s(\gamma)} \tag{2}$$

$$S(\gamma) = \sinh\gamma\ ;\ s(\gamma) = \sin\gamma \tag{3}$$

$$\gamma = \sqrt[4]{\frac{kL^4}{4EI}} \tag{4}$$

k = foundation modulus (lbs./in.^{3})
E = Young modulus of the beam
I = moment of inertia of the beam

The function $\bar{m}_\gamma$ is given in FIGURE 1.

*The Section of Biology held a meeting on January 13, 1958, at which Anna Goldfeder, Department of Biology, New York University, New York, N. Y., delivered a paper entitled "Ionizing Radiation as a Tool in Biological Research." This paper will appear in a later edition of the *Transactions*.

**This paper, illustrated with lantern slides, was presented at a meeting of the Section on January 17, 1958.

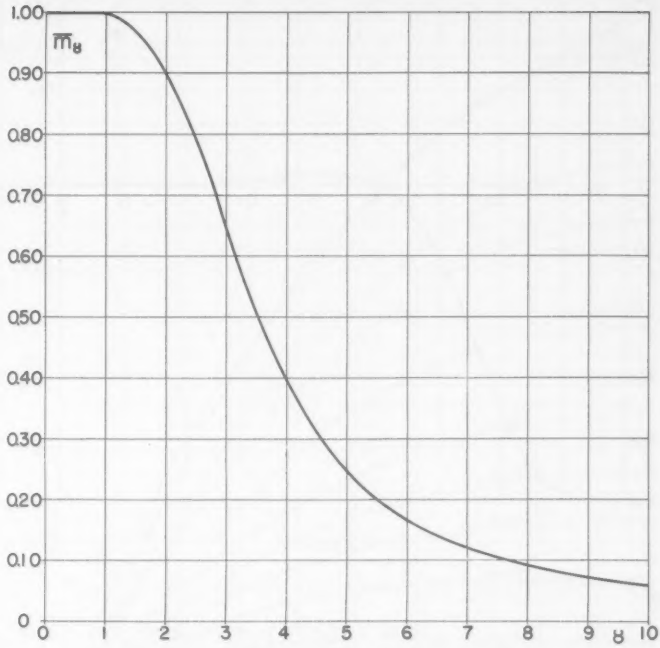


FIGURE 1.

Carry-Over Factors

From the expressions for the end rotations due to a moment applied at one end of a beam (Hetenyi, p. 62), the carry-over factor becomes:

$$c_\gamma = \frac{C(\gamma)\,s(\gamma) - S(\gamma)\,c(\gamma)}{C(\gamma)\,S(\gamma) - c(\gamma)\,s(\gamma)} \tag{5}$$

where

$$C(\gamma) = \cosh \gamma \;;\; c(\gamma) = \cos \gamma \tag{6}$$

The function c_γ is given in FIGURE 2.

Bending-Moment Diagrams

The bending-moment diagram due to uniform load q in a simply supported beam is given in Hetenyi, p. 60.

$$M_q(x) = \frac{q^2}{12}\, m_q(\gamma, x) \tag{7}$$

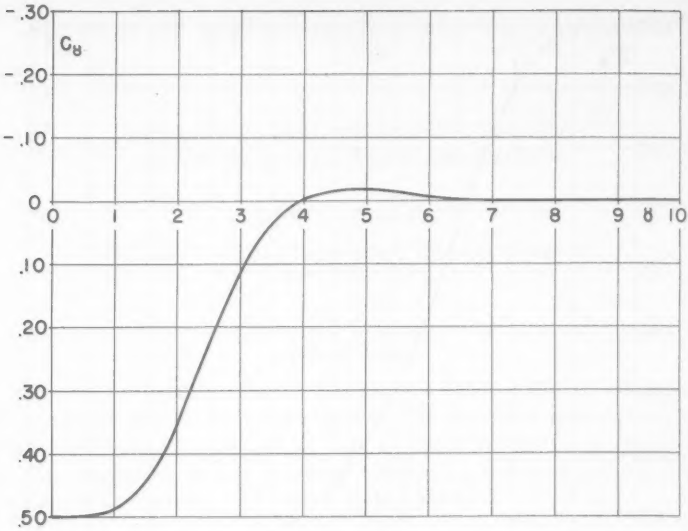


FIGURE 2.

where

$$m_q(y, x) = \frac{6}{y^2} \frac{S(x)s(x') + S(x')s(x)}{C(y) + c(y)} \tag{8}$$

$$S(x) = \sinh y\, x/L;\ s(x) = \sin y\, x/L;\ x' = L - x \tag{9}$$

x = longitudinal coordinate from left end of beam. The function $m_q(y,x)$ is given in FIGURES 3a and b.

The bending-moment diagram due to an end moment M_0 at $x = 0$ is given in Hetenyi, p. 62.

$$M_0(x) = M_0\, m_0(y, x) \tag{10}$$

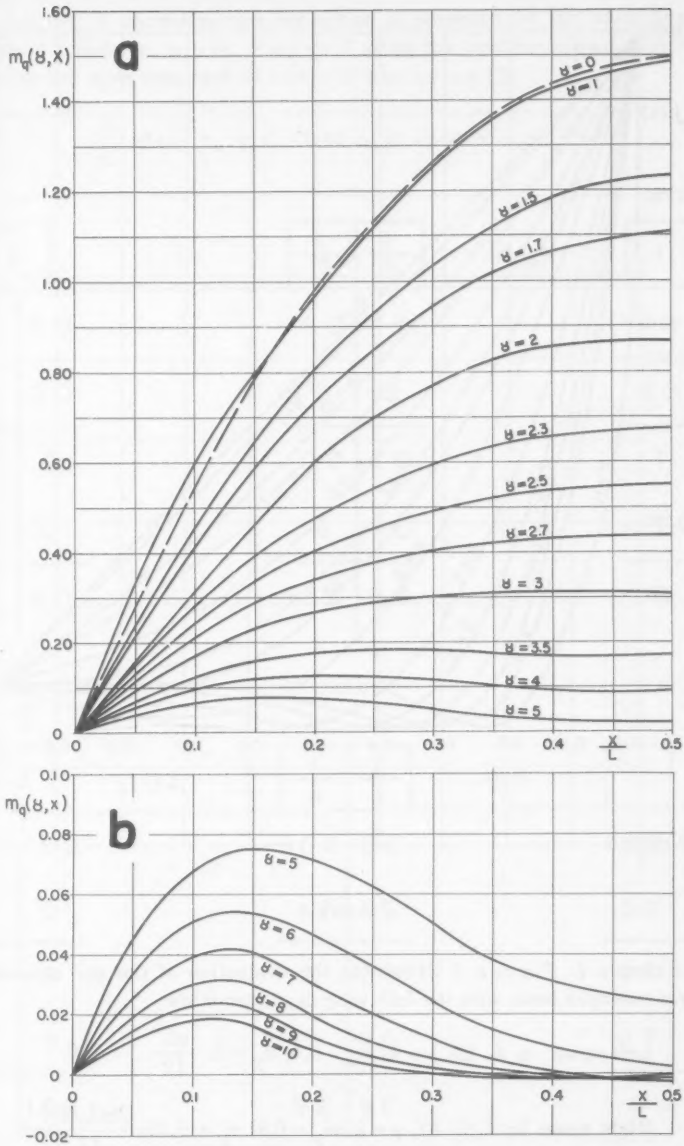
where

$$m_0(y, x) = \frac{C(y)c(x)C(x') - c(y)C(x)c(x')}{C^2(y) - c^2(y)} \tag{11}$$

The function $m_0(y, x)$ is given in FIGURE 4.

The bending-moment diagram for a beam loaded by a load q with end moments M_A and M_B is thus given by:

$$M(x) = \frac{qL^2}{12} m_q(y, x) + M_A\, m_0(y, x) + M_B\, m_0(y, x') \tag{12}$$



FIGURES 3a and b.

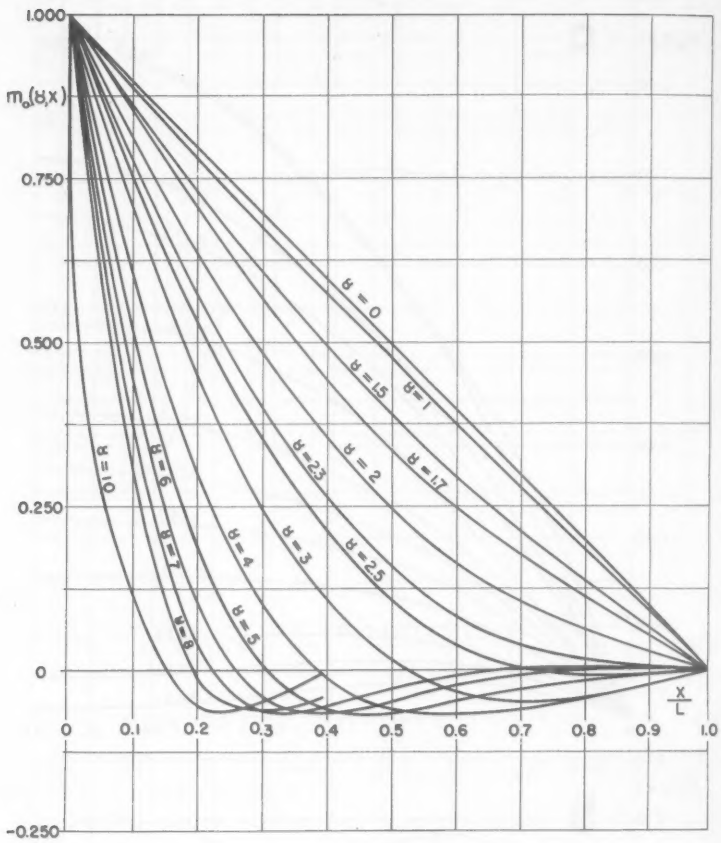


FIGURE 4.

Example 1. FIGURE 5 illustrates the evaluation of the end moments for a two-span beam with the following characteristics:

Left span: q, L, EI, $\gamma = 4$, $\bar{m}_\gamma = 0.4$; $c_\gamma = 0$; $\dfrac{qL^2}{12} = 100$

Right span: $2q$, $L/2$, EI, $\gamma = 2$, $\bar{m}_\gamma = 0.9$, $c_\gamma = 0.35$; $\dfrac{2q(L/2)^2}{12}$

$$= \frac{1}{2}\,\frac{qL^2}{12} = 50$$

FIGURE 6 illustrates the evaluation of moments for the same beam without foundation ($\gamma = 0$). FIGURE 7 gives the bending-moment diagram for the left span computed by means of EQUATION 12:

$$\frac{12}{qL^2} M(x) = m_q(4, x) - 0.40\, m_0(4, x) - 0.36\, m_0(4, x')$$

0		0		$\frac{1}{3}$	$\frac{2}{3}$	0.35	1
40				-40	45		-45
00				- 2	-3		45
0				00	-16		1
0				6	10		- 1
40				-36	36		0

FIGURE 5.

0		0.5		$\frac{1}{3}$	$\frac{2}{3}$	0.5	1
100				-100	50		-50
0				17	33		50
8				0	25		17
0				-9	-16		-17
108				-92	92		0

FIGURE 6.

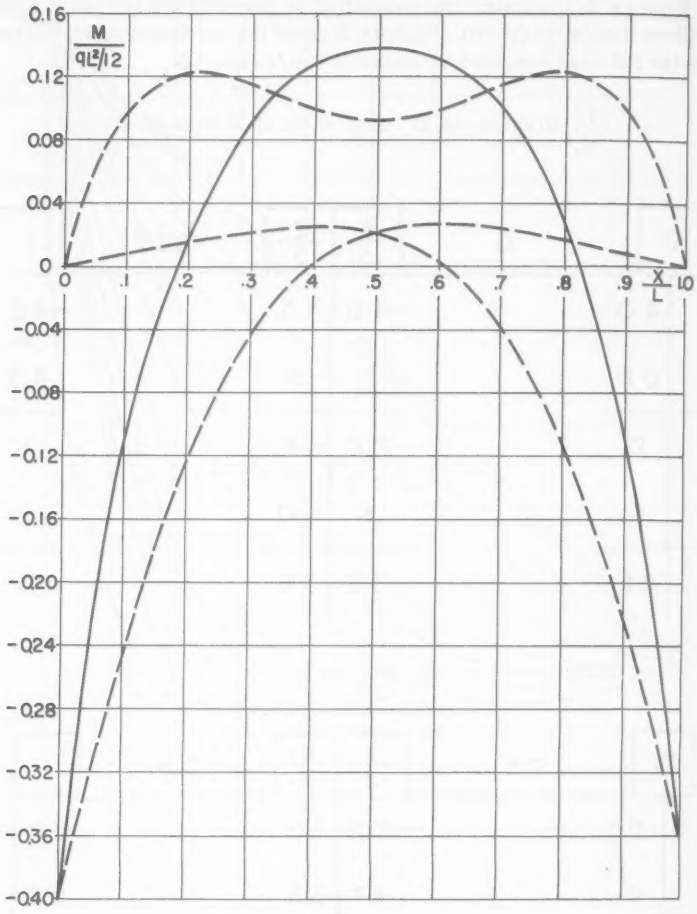


FIGURE 7.

Example 2. FIGURE 8 gives the evaluation of moments for the lower bays of a frame on an elastic foundation. The load q on the beam is evaluated by dividing the total load on the frame by the length $4L$ of the foundation beam. The characteristics of the frame are:

Outer spans: $q, L, k, EI, \gamma = 2, \bar{m}_\gamma = 0.9, c_\gamma = 0.35, \frac{qL^2}{12} = 1000$

Inner span: $q, 2L, 2k, 2EI, \gamma = 4, \bar{m}_\gamma = 0.4; c_\gamma = 0; \frac{q(2L)^2}{12} = 4000$

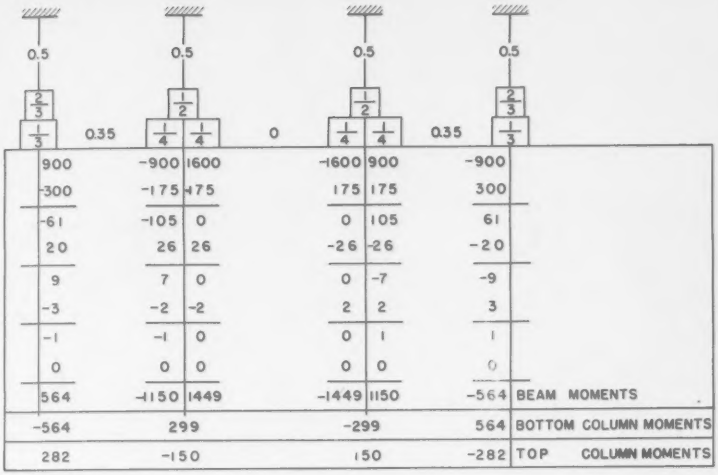


FIGURE 8.

Columns: $q = 0$, L, EI, $\gamma = 0$; $\bar{m}_\gamma = 1$, $c_0 = 0.5$

Example 3. A pipe of radius a and thickness h, resisting an internal pressure p, is supported on 3 rings and built in at one end, as shown in cross section in FIGURE 9. Each strip of beam of width one is known to behave as a beam on an elastic foundation in which:

$$\gamma = \sqrt[4]{3(1-\mu^2)} \quad L/\sqrt{ah} \tag{13}$$

where μ is Poisson's ratio.

Choosing:

$$L = a/4;\ 2L = a/2;\ h = a/50;\ \mu = 0.3;$$

the values of γ and $\bar{m}_\gamma$ are:

Short spans: $\gamma = 2.3$; $\bar{m}_\gamma = 0.83$

Long spans: $\gamma = 4.6$; $\bar{m}_\gamma = 0.30$

Letting: $0.83 \dfrac{L^2}{12} = 100$, and hence $0.30 \dfrac{p(2L)^2}{12} = 144$

the evaluation of moments is carried out as shown in FIGURE 10.

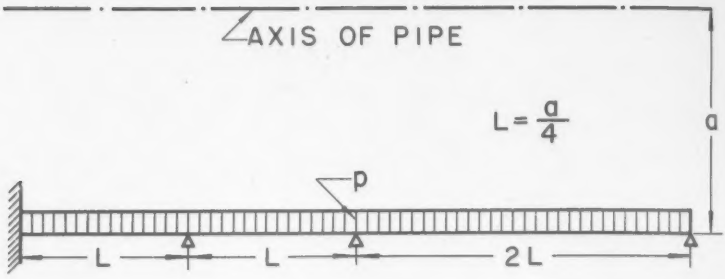


FIGURE 9.

0	0.28	1/2	1/2	028	1/3	1/3	− 0.02	1
100		-100	100		-100	144		-144
0		0	0		-29	-15		144
0		0	-8		0	-3		0
0		4	4		2	1		0
100		-96	96		-127	127		0

FIGURE 10.

Reference

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DIVISION OF MYCOLOGY

FUNGI AND PLANT DISEASES IN RELATION TO BIOGEOGRAPHY*

By I. Reichert

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Not long ago even some mycologists believed that fungi were capable of world-wide spread without major hindrances.[10] This viewpoint was in direct contradiction to findings made in higher plants by the classical plant geographers, who had observed that their distribution was definitely governed by climatic and paleohistorical factors. It was my good fortune to have been given an assignment by Adolph Engler, the well-known plant geographer of Berlin, Germany, to help clarify this obscure problem. This work was carried out from 1917 to 1920 on a large collection of fungi from Egypt assembled by G. Ehrenberg in 1820. A taxonomic and biogeographic analysis of these fungi demonstrated that Egyptian specimens identical with fungi of other countries shared similar climatic conditions. Conversely, where the climatic conditions of Egypt differed strongly from those in other countries, fundamental differences in the composition of the fungus flora were observed. This Egyptian study offered conclusive evidence that spontaneous fungi are subject to the same biogeographical laws as higher plants.[2]

This study and my later studies in Palestine[3-9] revealed that any biogeographical analysis of all organisms cannot be considered adequate unless approached from the following four viewpoints:

(1) The distributional or geographical aspect: taking into account the mere occurrences without reference to the environment. Each plant examined from this point of view is called by us the organism's biogeographical or distributional "component."

(2) The ecological aspect: bringing the plant into relationship with its environment. An examination from this point of view presents the organism as an ecological or biogeographical "type."

(3) The paleohistorical aspect: revealing the place of origin of the plant. Evaluated from this angle, each plant is termed the biogeographical "element."

(4) The migratory aspect: tracing the routes the plant has followed during its migration. Each plant examined from this viewpoint is classified as a biogeographical "migrant."

*This paper, illustrated with lantern slides, was presented at a meeting of the Division of Mycology on January 24, 1958.

I propose to demonstrate how these definitive terms may be integrated in the study of the fungi as well as of plant diseases in general by using *Sclerotinia sclerotiorum* as an example. This plant is a parasitic fungus that attacks many economic annual plants throughout the world, causing fruit and stock to rot and to wilt. It belongs to the family Sclerotiniaceae, most of whose members live on spontaneous host plants.[11] The pattern of distribution of this parasite is shown in FIGURE 1. We see here that the *Sclerotinia sclerotiorum* disease is largely found in the temperate regions of the Northern Hemisphere, with occasional occurrences in the tropics, as in parts of India, in Queensland, Australia, and other similar regions. It shows, therefore, a cosmopolitan pattern of distribution. Thus, *Sclerotinia sclerotiorum* may be called a cosmopolitan component.

If we proceed to the ecological aspect and ask ourselves if the distributional pattern shown above also reflects its ecological behavior, then we must say that this is not the case. Laboratory examinations show that *Sclerotinia sclerotiorum* requires high humidity (about 90 per cent) with a moderate temperature (between 15°C. and 24°C.) for its optimal growth, with its extreme limits of growth at 1°C. and 32°C. maximum.[11] The ecological pattern, as we see, coincides with the climate prevailing in the northern temperate regions of both hemispheres during the summer. Indeed, the concentration of the occurrences of *Sclerotinia sclerotiorum* is found in these regions during this season. Where this disease is found in the tropics, it is associated with higher elevations where cooler wet conditions like those of the northern temperate summer prevail. M. Mehta, who worked on this plant parasite in India, brought to our attention the fact that *Sclerotinia sclerotiorum* in his country will survive only in very particular elevated regions where wet, comparatively cooler conditions exist. In the Mediterranean countries and in the southwestern United States the occurrence of the disease also coincides with the cool wet season.[11] According to the above ecological characterization, we may classify *Sclerotinia sclerotiorum* as a temperate ecological type.

With reference to the paleohistorical aspect, we find that the above ecological characterizations of *Sclerotinia sclerotiorum* lead us to assume that it derives from the northern temperate regions with the climate of which it is in full accord. This assumption is supported by the biogeographic systematic method accepted in botany and zoology: that the region in which the majority of the related species is found may also be considered the place of origin of the species concerned. As may be seen on the map of distribution of the related species to *Sclerotinia sclerotiorum* (FIGURE 2), all of these thirteen spontaneously distributed species, which do not include *Sclerotinia sclerotiorum*, *Sclerotinia trifoliorum*, and *Sclerotinia minor* because of their cosmopolitan distribution, are con-

FIGURE 1. Distribution of *Sclerotinia sclerotiorum* (Lib.) De Bary, showing the occurrence of the pathogen in various climatic regions, thus presenting a cosmopolitan distribution.

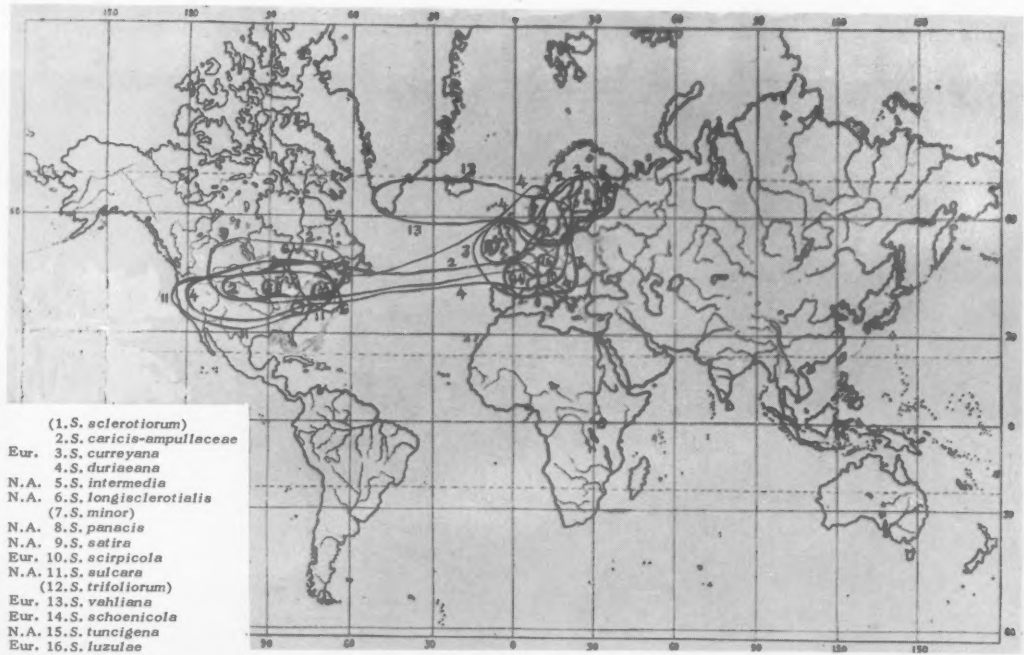

FIGURE 2. Distribution of all the known species of the genus *Sclerotinia*. Excluded are the three cosmopolitan species (included in parentheses): *S. sclerotiorum*, *S. trifoliorum*, and *S. minor*. All are concentrated in the temperate region of the Northern Hemisphere.

centrated in the temperate region of the Northern Hemisphere: five in Europe, six in North America, and two others that are common to both hemispheres. This reveals that the temperate zone of the Northern Hemisphere is the ecological homeland of *Sclerotinia sclerotiorum*.

An additional support for this contention is the distribution of all the genera included in the family Sclerotiniaceae (FIGURE 3*). Here we see that all the fifteen genera are concentrated in the temperate region of the Northern Hemisphere. These results again corroborate the above assumption very nicely. Whereas the species map showed a roughly even distribution of the species both in Europe and in North America, the generic map narrows down the area of origin to the northern temperate zone of North America – in that all fifteen genera are to be found in this zone; eight of them are entirely endemic to North America, while seven are common to both continents.[13, 14] From this it follows that the centrum of genes is to be found in North America and not in Europe. On the basis of the foregoing discussion, we may thus designate *Sclerotinia sclerotiorum* as a North American element.

As for the migratory aspect: from the above conclusion that the place of origin of Sclerotiniaceae is to be found in North America, one may assume further that the genera and most of the species of the family – amongst them, *Sclerotinia sclerotiorum* – migrated from North America to Europe during the Tertiary era, when land bridges between these continents existed. *Sclerotinia sclerotiorum* may thus be called a Tertiary migrant.

These conclusions can have rich implications for world-wide agricultural practices: for one thing, we may safely avoid the appearance of *Sclerotinia sclerotiorum* by growing susceptible crops only in hot and arid areas.

By investigating the centers of origin of the disease, one might quite reasonably expect to find varieties resistant to the disease. This was the case with *Oïdium* of the grapevine in North America, and with *Phytophthora*, which affected potatoes in South America. In both cases resistant varieties of these crops were developed.

It is also important to determine the origin of the plant disease since, in the same area, the antagonistic organism for control of the pathogen may likewise be found. This possibility has been demonstrated by Roger Heim,[1] who found an antagonistic *Penicillium* to the pathogen of *Fusarium* wilt of oil palms in the Cameroons, West Africa, to which both are indigenous.

*In FIGURE 3, the genus *Lambertella* is not included because data were not available at that time. A later perusal of the literature[12] showed that this genus is also common to Europe and North America.

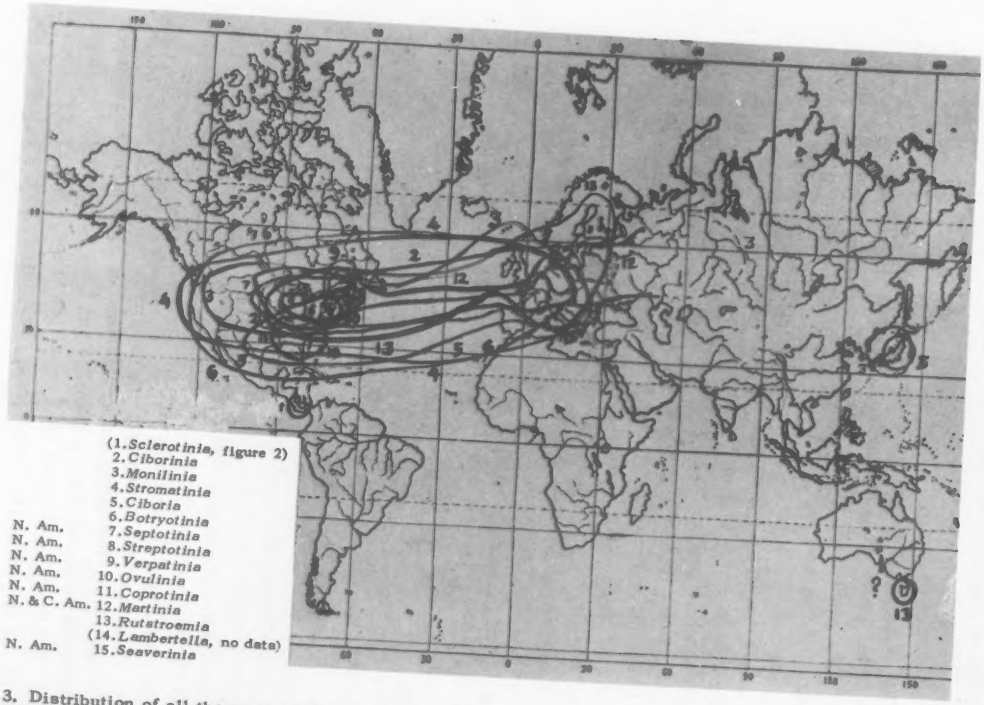

FIGURE 3. Distribution of all the genera belonging to the family Sclerotiniaceae, with the exception of *Sclerotinia* (shown in FIGURE 2) and *Lambertella* (see footnote, page 337).

Summary

(1) The above biogeographical analysis of *Sclerotinia sclerotiorum* demonstrates that fungi of plant diseases are subject to the same biogeographical factors dominating higher plants. When applied to fungi, this method of approach may be called "mycogeography"; when applied to plant diseases, it may be termed "phytopathogeography."

(2) The phytopathogeographical method enables us to ascertain the ecological character of the pathogen and from this to draw conclusions as to the manner of preventing the disease: by being able to predict its appearance, and by selecting the place and period least favorable to its development.

(3) In determining the paleogenetic centers of the pathogen in question, one may discover the existence of resistant varieties of the host plant, as well as the organism antagonistic to the pathogen.

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SECTION OF ANTHROPOLOGY

SPIRITS, MEDIUMS, AND BELIEVERS IN CONTEMPORARY PUERTO RICO*

By Joseph Bram

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Animism or the belief in spiritual beings is one of the oldest inventions of man. If we can trust inferences from archaeological data, this belief goes back to Paleolithic times. It has been found in all culture areas; there is no doubt as to its world-wide distribution.

While not denying the omnipresence of animistic beliefs, ethnologists tend to underscore their extreme diversity as to form, contents, and functions. This legitimate stress on specific variants, however, should not obscure the existence of broadly overlapping patterns that occur in geographically and historically isolated cultural worlds.

One of these patterns depicts man as endowed with a spiritual substance: his soul, which is the seat of his individual identity. The soul is regarded as being in sharp antithesis to man's material nature. It is invisible and ethereal and not uncommonly related to such concepts as breath or wind (*pneuma* in Greek, *anima* in Latin, and *atman* in Sanskrit). Death is the loss or the departure of the soul, and a disembodied soul becomes a spirit and enters the spirit world.

Such a spirit may sometimes preserve a residual materiality. Thus, among the Eskimo the spirits of the dead are believed to be vulnerable to sharp instruments. In Europe and elsewhere spirits are capable of remaining visible in the form of pale graveyard ghosts.

The most socially significant characteristic of such spirits is their failure to disengage themselves from earthly involvements. Sheltered by the immunity of the "other" world, these spirits take part in the affairs of the living, protect their kin, pursue their enemies, and attend to various kinds of unfinished business.

One of the most levelheaded thinkers England has produced, Jeremy Bentham (1748-1832), confessed in his old age that ghosts and the fear of them had been among the torments of his life. The erudite and witty Madame de Staël (1766-1817) once said "I do not believe in ghosts, but I am afraid of them." Even Immanuel Kant (1724-1804) evidently shared in the beliefs of his time, as witnessed by the following excerpt from his *Träume Eines Geistersehers (Reveries of a Contemplator of*

*This paper was presented at a Meeting of the Section on January 27, 1958.

Spirits): "I do not care wholly to deny all truth to the various ghost stories, but with the curious reservation that I doubt each one of them singly, yet have some belief in them all taken together ...."**

The belief in spirit survival is often accompanied by the conviction that some individuals (in modern parlance known as mediums) possess the faculty of inducing a special psychological state (usually referred to as a trance) that enables them to communicate with the spirits of the dead. Sometimes these individuals must rely on the assistance of an obliging spirit (their "familiar" or "control") who facilitates their contact with the spirit world.

The most socially significant aspect of the spirit-medium relationship is the spirit's willingness to lend the benefit of his supernormal capacities to the medium or to the medium's client or patient. Thus, by availing themselves of the services of a medium, men may gain knowledge of hidden facts, locate lost property, look into the future, and obtain aid and relief in various predicaments.

We read in Herodotus (*The Fifth Book,* chapter 92) how Periander, the tyrant of Corinth, sent to the *nekromanteion* (oracle of the dead) to make an inquiry of his dead wife Melissa regarding a money matter of which she alone had knowledge. After he had met her conditions, she complied with his request and divulged the needed information.

One of the oldest descriptions of a mediumistic séance is found in the *Old Testament,* I Samuel XXVIII, 5-25. We read there that the witch of Endor, a medium, obliged King Saul and, with the assistance of her "familiar," evoked the spirit of Samuel, who proceeded to berate Saul for his failure to obey the Lord.

Ethnographic literature from Siberia, China, Japan, Indonesia, Melanesia, India, and Africa is replete with records of beliefs and practices built around the invocation of the dead by the mediums. Overlappings in essential features are such that a disciple of Jung could easily claim for this pattern a place in the "collective unconscious" of mankind as one of its identifiable "archetypes." A more cautious anthropologist might prefer to think in terms of Adolf Bastian's (1826-1905) concept of *Elementargedanken (Elementary Ideas).*

If we now approach the spiritualist movement of the Nineteenth Century with a proper ethnological perspective, we become aware of a long series of preliminary phases – the prehistoric, the ancient Eastern Mediterranean, the contemporary primitive, the early and medieval Christian, and even the modern philsophical one (from E. Swedenborg to V. Solovyov). This is *not* an evolutionary sequence by any means, but rather a reiterative chain of patterns duplicating, echoing, rephrasing, and reinforcing one another.

**Quoted by William Oliver Stevens, *Unbidden Guests,* New York, N. Y., 1946, pp. 9-10.

In the light of these observations one should be prepared to understand the enthusiastic reception with which numerous people in the United States and in Europe met the peculiar happenings of Friday, March 31 of 1848, in Hydesville, N. Y. A Canadian farmer, John Fox, had moved with his family into a house previously occupied by a tenant named Weekman. Weekman had left the house because of inexplicable noises that annoyed him. As soon as the Fox family moved in, they too were subjected to the same mysterious rappings. One of the Fox girls, Catherine, half-jokingly challenged "Mr. Splitfoot" (presumably someone built in the image of the devil) to answer her questions by using a code of one, two, or three raps for different replies. The success of this playful suggestion surpassed all expectations. The cause of the noises turned out to be the spirit of a peddler who accused the previous owner of the house, a Mr. Bell, of having robbed and murdered him. Although no body was found in the cellar of the house at the time (one seems to have been discovered in 1904), the news of this unusual contact with a dead person had spread like wildfire. Crowds of pilgrims trooped to Hydesville. The sisters Fox, sponsored by Horace Greeley, moved to the city of New York. Later they gave demonstrations of their mediumistic powers in Europe. The spiritualist movement was born. Numerous mediums made their appearance, among them several celebrities such as D. D. Home, Leonora E. Piper (discovered by William James), and the internationally famous Eusapia Palladino. Among many eminent followers of the movement we recognize the names of the French astronomer Camille Flammarion, the biologist A. R. Wallace, the physicists Sir William Crookes and Sir Oliver Lodge, the writer Sir Arthur Conan Doyle, and others equally renowned.

Several American and European authors made attempts to develop spiritualist contentions into a body of doctrines. Among them Hippolyte Rivail of Lyons, France, known as Allan Kardec (1803-1869) proved particularly popular in the Spanish-speaking countries. Summarized briefly, his teachings advance the following claims. The spirits of the Lord are spread all over the cosmic world. They communicate with mankind through numerous mediums. True mediums know that their role is a passive one and simply lend themselves to spirits. Spirits differ in abilities, knowledge and moral character. Some are ignorant, others mislead men deliberately. Spirits' messages must be checked against common sense and logic. Human souls go through numerous reincarnations interrupted by periods of interplanetary wandering. Incompletely spiritualized impure souls are occasionally seen as ghosts. Kardec claimed that there is no conflict between the Scriptures and spiritualist teachings. In fact, spiritualist revelations provide clues to the more obscure passages of the Bible. "In my father's house are many mansions ..." (John 14:2) is interpreted as a reference to the many astral homes where spirits of

varying degrees of moral perfection are incarnated. This succession of reincarnations is felt to be superior to the definitive fixed afterlife, either in Heaven or Hell, taught by the churches. As embodied beings we have no recollection of previous lives, but after death as spirits we reacquire a clear memory of all our successive reincamations.

Among many areas of the Occidental world, the miracle of Hydesville and the writings of Allan Kardec made their influence felt in a relatively isolated colonial outpost of Spain – the island of Puerto Rico. The learned historian of Puerto Rico, Lidio Cruz Monclova, cites good evidence in stating that the evocation of spirits was in great vogue at fashionable parties in Puerto Rico as early as 1856. The earnestness with which this movement was propagated on the island is illustrated by the list of periodicals published there in the service of the spiritualist cause. Some were ephemeral ventures, the exact life span of others could not be established, but quite a few endured for from five to fifteen years (based mainly on Antonio S. Pedreira, *El Periodismo in Puerto Rico*, Havana, Cuba, no date). These periodicals are: *El Heraldo*, 1880; *El Peregrino*, Caguas, 1884; *Luz y Progreso*, Mayagüez, 1885-1886; *El Nivel*, Vega Baja, 1889; *Iris de Paz*, Mayagüez, 1900-1912; *El Boletín Espiritista*, San Juan, 1906; *El Buen Sentido*, Ponce, 1906-1913; *Luz de Oriente*, Puerta de Tierra, 1906; *Luz Espiritual*, 1907; *Fiat Lux*, Ponce, 1911-1916; *Emancipación*, San Juan, 1913; *El Padre Germán*, San Juan, 1914; *Espírita*, Moca, 1917; *Fraternidad*, San Juan, 1919-1929; *Heraldo Espírita*, San Juan, 1925; *El Bien*, San Juan, 1927; *Fuente de Luz*, San Juan, 1929; *Espiritualismo*, Caguas, 1931; *La Reforma*, San Juan, 1933; and *Cosmos*, Ponce, 1941-1956. Twenty-one specialized periodicals, emanating from seven urban centers over a period of 75 years, do seem to testify to the popularity of spiritualism in Puerto Rico. My field work and that of others among Puerto Ricans in New York, N. Y., and on the island itself has confirmed this impression, even though no numerical estimate could be attempted.

What are some of the traits of this movement that may account for its appeal? Leaving the task of providing a definitive answer to this question to historians, one can nevertheless suggest a few leads. From the founding of the first Spanish settlement (Caparra) in 1508 and until 1898, when sovereignty over the island was transferred to the United States, Puerto Rican education and religious life were in the hands of the Roman Catholic Church. Protestant activities were prohibited, but as spiritualism was outside the strictly denominational category, it could carry on its propaganda and fill the need for ideological alternatives to the state-supported world view.

It must also be remembered that Nineteenth Century spiritualist doctrines were advertised in Puerto Rico as in other Latin lands under the auspices of scientific positivism, humanism, and social evolution. Some of the above-listed periodicals carried on their mastheads references to

biology, psychology, and sociology. Their readers did not seem to discriminate between reputable scientific disciplines and their verbal trappings.

At a spiritualist convention held in Mayagüez, Puerto Rico, in April 1903, one of the speakers announced a new basis for modern psychiatry. He claimed that since phenomena of hypnosis, in which the hypnotist bends to his will the personality of his subject, have been validated and incorporated into medical therapy, the day had come when one should recognize that most mental diseases were produced by the spirits' hypnotic influence on the minds of afflicted persons. Thus spiritualism would become an extension of psychiatry, and its exorcistic rituals would join the arsenal of psychiatric therapy.

To this day one finds on the bookshelves of Puerto Rican spiritualists, as well as in special sections of the bookstores, an easily recognizable brand of esoterica – composed of the works of Allan Kardec, theosophy, anthroposophy, Rosicrucian doctrines, Yoga teachings, hypnotism, graphology, endocrinology, psychosomatic medicine, and psychoanalysis.

Insisting that their preferred literature is scientific and profoundly philosophical, Puerto Rican spiritualists make every effort to differentiate themselves in the public mind from the practitioners of witchcraft, magic, and healing practices that have been an element of Puerto Rican folk-culture for centuries. Actually, the dividing line between the respectable *espiritistas* and the less respectable *espiriteros* and *curanderos* is more clear-cut in theory than in practice. In fact, the easy acceptance of spiritualist teachings by the literate classes of Nineteenth Century Puerto Rico can be traced in part to the influence of nursemaids, servants, and rural playmates on the children and the women of the upper classes. Thus "superstitions" of Indian, African, and Spanish origin surviving on the popular level had prepared the soil for the seeds of the somewhat more sophisticated imported variations on the same themes. This becomes apparent if one stresses the fact that pure and orthodox spiritualism is limited to the communication between the spirits of the dead and individual mediums. Puerto Rican spiritualism, as a configuration of beliefs and activities, has been invaded by phenomena of possession, by spirit malevolence, and by the direct apparition of spirits to nonmediums. Thus, instead of drawing a rigid line between the two levels on which spiritualism functions today, one may be well advised to view it as a continuum, with idealistic theists and reincarnationists at one end and the devotees of popular magic and exorcisms at the other. The picture is blurred, furthermore, by the unavoidable adhesions between supernormal phenomena (on both "higher" and "lower" levels) on the one hand and the phenomena of mental pathology on the other. Here are a few case stories illustrating the mingling of these elements.

The employer of a servant girl summoned a physician in the belief that the girl was having an epileptic seizure. Recognizing the hysterical nature of the convulsive pattern, the doctor remarked within the girl's hearing that she was probably "possessed." A few minutes later, the girl spoke with the voice of the "possessing" spirit, which turned out to be that of a recently deceased rejected suitor who had come to settle his accounts with her.

In another case, a servant girl went around the house of her employers, pushing people and butting into furniture. A young medical student present at these events grabbed her by the arms and shook her energetically while addressing the alleged "evil spirit" in her. This treatment had the desired effect. The spirit spoke a few words and vanished in the thin air, while the girl returned to her usual behavior.

In both these cases the therapists, the patients and, we might add, the spirits have acted their parts in accordance with the culturally defined pattern.

In another case, a young middle-class woman, reliably diagnosed as a schizophrenic patient, acted out in her bedroom lively love scenes with an imaginary and invisible man, This occurred in her home, and her family were inclined to believe that she was having an affair with a spirit-lover.

Under fairly similar circumstances, another schizophrenic woman patient acted out scenes of resistance to an invisible suitor's aggressive advances. She would rush out of her room to brush her teeth after the repellent kisses to which she had been forced to submit. In this case the family had accepted the spirit version of the girl's delusional behavior.

In a small town on the south coast the young daughter of well-to-do parents was dying of tuberculosis. Despairing of medical science, her family called upon a woman medium. After an hour spent in the patient's room, the medium declared that the girl was being "possessed" and harmed by the spirit of a recently deceased man who had been ruined by the questionable money deals of the girl's father. The spirit was now using the girl to revenge himself upon her father and, at the same time, to pass his own tubercular affliction on to another person, as "spirits usually do."

A "crossing of the wires" between spiritualist beliefs and clinical phenomena takes a variety of forms. Thus, a peasant girl was treated because of her habit of eating crushed glass. She claimed that she did it to comply with the orders of the spirits. A chronic alcoholic explained his inability to cope with his addiction in almost the same terms.

The Spanish scholar Pablo Garrido* reports a case in which a young woman abandoned by her husband was ordered by the spirits (acting

*_Esoteria y Fervor Populares de Puerto Rico_, Madrid, Spain, 1952, p. 36 ff. which may be freely translated as _Popular Esoteric Beliefs and Devotional Sentiments in Puerto Rico_.

through a medium) to commit suicide. The woman's husband was informed of this threat and returned to his wife to protect her. Subsequently the spirits told him that he must kill her. Despairing and confused, he made an attempt on his wife's life and wounded her with a pistol shot.

The occasional complementary nature of the psychiatrist-medium relationship is exemplified by the following case. A respectable-looking middle-class woman brought her 24-year-old son to the psychiatrist's office. The young man was subject to a daily vision of a young woman dressed like a saint, who urged him to become a model of piety. The mother took his case up with a medium who interpreted the young man's visions as a sign of growing mediumistic faculties *(facultades)*. She had brought him to the psychiatrist's office because he was also given to fits of violence, which the medium regarded as interfering with his spiritual growth.

Most Puerto Rican mediums are women who are sometimes of a social status lower than that of their clientele. It is not unusual for a group to meet in their medium's home. Sometimes two or more mediums operate jointly, seated at the table in the center of the room; their followers sit along the walls. When more than one medium is active, one usually becomes the chairman, whose role is to give the cues for readings, prayers, and mediumistic vaticinations. Lights are turned down, but not out, and a record of inspirational music may be heard.

The onset of the trance is marked by trembling and jerking movements, changes in the facial expression, and a changed tone of voice on the part of the medium. The chairman and those around the table protect the medium against her (or his) own frenzy and against the malevolence of an occasional aggressive spirit. This protection takes the form of repeated prayers and of sheltering hands spread over the convulsed medium's head.

The medium "free-associates" to the texts read (anything from Allan Kardec to Aldous Huxley), relays spirit messages to those present, and mixes moral advice with references to medicinal herbs. By the time the séance is over all those present have had their share of attention and have had a chance to say a few words about their personal problems. Over a period of time, those attending the same gathering get to know one another well, and a genuine group-therapeutic situation is in operation.

An intelligent medium endowed with charismatic qualities may become a highly revered and influential counselor and guide. A well-known lawyer who had been distressed by the death of his young son took up painting on the advice of such a medium. "You don't have to learn how to paint, your son will guide your hand," he was told. This man is now known as a gifted amateur artist, has exhibited his canvases and, incidentally, has found comfort in the thought that his artistic pursuits had been suggested by his son's spirit.

As a last thought on spiritualism, one must not forget that its principal function is to reconcile man to the thought of death. Four socially prominent men from San Juan, the capital of Puerto Rico, crashed into the ocean on their return flight from the Virgin Islands. A few days later (August 14, 1957) the front page of *El Mundo* (the largest newspaper of the island) carried an account of messages two of the deceased men had communicated through mediums at a séance held in the home of friends. The men were spiritually alive, although they knew their bodies had been caught in the sinking plane. They appeared sad and puzzled, and their unsolicited message turned the séance into a profoundly moving experience for those present.

It has been the intent of this report to present as many-sided a portrayal of the spiritualist movement in Puerto Rico as evidence permits. There is a great deal of latitude and variety in levels of knowledge, ritual patterns, and beliefs and attitudes within its confines. Nevertheless, the core is there, as in the historical and ethnographic instances already mentioned of the belief in survival after death and in communication between the spirits and the living.

Acknowledgment

I acknowledge my indebtedness to Harold Alksne of New York, N. Y., through whom I made my first contacts with Puerto Rican spiritualists. I also express my appreciation to Rafael de Guzmán and Manuel Torres Aguiar, psychiatrists of San Juan, for their invaluable assistance in research while I was in Puerto Rico.

SECTION OF OCEANOGRAPHY AND METEOROLOGY

A NEW USE FOR WEATHER RADAR*

By Donald M. Swingle

United States Army Signal Engineering Laboratories, Fort Monmouth, N. J.

During World War II the rapid development of microwave radar led to the discovery that it was feasible to use such equipment for detecting precipitation in the atmosphere. Such a radar could maintain continuous surveillance of all precipitation over large areas. The United States Army Air Force therefore requested the Chief Signal Officer to develop a weather radar capable of detecting thunderstorms within a radius of 200 miles. This equipment, constituting one of the most sensitive radars ever built, was developed during the period from 1945 to 1950 and was procured for use by the Air Force during the early 1950s.

Today the United States Weather Bureau operates a network consisting of approximately sixty modified military radars of varying sensitivities and capabilities. In addition, the Air Force and Navy operate a network of twenty-nine of the higher sensitivity storm detection radars, Radar Set AN/CPS-9 developed by the United States Army Signal Engineering Laboratories, Fort Monmouth, N. J. As a consequence, there is fairly good weather radar coverage over most of the eastern and central United States.

Coordination between the several federal government agencies operating weather radar equipment has resulted in a standard set of procedures for observing and reporting weather echoes. These reports are consolidated by the Radar Analysis and Development Unit, United States Weather Bureau, Kansas City, Mo., and disseminated hourly in condensed form as SD-1 messages. This system is far better than those used in the past, although it is obvious that it cannot hope to exploit or even to handle the great mass of detail that the weather radar net now operating is capable of generating on such things as a wave cyclone or a summer afternoon squall line. Perhaps some day the requirements for detailed forecasting will require the establishment of a facsimile or other picture transmission system that will permit the complete detail observable at each station to be transmitted into regional or national analysis offices.

Recent studies tend to support the view that in time meteorology may grow sufficiently accurate and develop sufficient understanding of the smaller-scale atmospheric processes to make such collected reports

*This paper, illustrated with lantern slides, was presented at a meeting of the Section on January 28, 1958.

indispensable inputs to the forecasting process. Reports with small-scale weather phenomena analyzed by radar have been presented by numerous authors during the six Weather Radar Conferences held since 1947.

The weather radar data transmission problem has attracted the efforts of a number of people, with the result that several code systems for teletype transmission, as well as several methods of picture transmission, have been developed. One of the latter, developed by the United States Army Signal Engineering Laboratories, was designed specifically to accompany Radar Set AN/CPS-9. It will accept photographs taken on standard Polaroid film of any of the AN/CPS-9 radarscope presentations and will reproduce these as Polaroid prints or transparencies after transmission over a wire or radio facsimile circuit. Other systems such as microwave link, or otherwise slowed down or partially encoded video and television, have been either considered or subjected to experimentation.

Aside from the problem of data transmission, which is the central problem preventing a larger-scale analysis and synthesis of weather radar data, considerable work has been done in further investigations of the nature and signficance of radar echoes. The most active of the radar organizations conducting this work have been the Massachusetts Institute of Technology, Cambridge, Mass., the University of Illinois, Urbana, Ill., the Agricultural and Mechanical College of Texas, College Station, Texas, and McGill University in Montreal, Canada.

The latter organization, for instance, recently has created an experimental constant altitude plan position indication known as CAPI. Such a device permits one to study the character of the precipitation process at various levels in the atmosphere and thus obtain a superior understanding of the over-all meteorological situation. Although most radars now in being are ill suited to this type of display, the CAPI offers exciting possibilities for future development, particularly since it is this type of analysis that is most often used by practicing meteorologists.

At Texas Agricultural and Mechanical College, Myron G. H. Ligda has supervised a research study that assembled the weather radarscope photographs from a large number of radars to obtain consolidated weather radar echo maps covering large sections of the country. It seems clear that much more data are available at the radarscopes than are now being transmitted and interpreted by the consolidation center. If these data are further multiplied by division into altitude slices, it becomes clear that a most powerful tool for analyzing meteorological situations, including precipitation processes, awaits only adequate means for transmission of the data.

At the University of Illinois, personnel of the Illinois State Water Survey Division have been actively pursuing a research program directed toward a quantitative evaluation of precipitation from radar echo intensities. The resulting reports, which have been fairly extensive, indicate that radar may be used for obtaining precipitation estimates over large

areas where numerous rain gauges might not be feasible or desirable. An additional phase of this work has included detailed analysis of the smaller-scale features of the weather. This has been principally in connection with the detailed analysis of the 1947 Thunderstorm Project data. In this analysis it has been shown that generally smaller-scale circulation patterns having persistence, organization, continuity, and presumably predictability exist even down to scales detectable or observable by stations separated by average distances of only two miles. This, of course, is the sort of resolution that one normally expects of a weather radar.

At the Massachusetts Institute of Technology extensive work on the analysis of the radar echo in terms of intelligence contained in the fluctuation of the echoes and in the analysis of the radar data in terms of the precipitation process has been in progress.

The work of these and many other organizations working in and/or adjacent to weather radar has been presented most effectively through the medium of the six Weather Radar Conferences already mentioned. These conferences have been sponsored by the more active organizations in association with the American Meteorological Society, Washington, D. C., the Institute of Radio Engineers, New York, N. Y., and the American Geophysical Union, Washington, D. C.

The first was an informal meeting sponsored by the Massachusetts Institute of Technology and held in Cambridge, Mass. in 1947. In 1951 the second Weather Radar Conference was sponsored by the Illinois State Water Survey Division at Urbana, Ill. In 1952, the Third Weather Radar Conference was held at McGill University. In 1953, the Fourth Weather Radar Conference was held at the University of Texas, Austin, Texas, and sponsored by the American Meteorological Society, the Institute of Radio Engineers, and the International Radio Scientific Union, Geneva, Switzerland. In 1955, the Fifth Weather Radar Conference was held at Asbury Park, N. J., sponsored by the United States Army Signal Engineering Laboratories and the American Meteorological Society. In 1957, the Sixth Weather Radar Conference was held in Cambridge, Mass., under the sponsorship of the Air Force Cambridge Research Center, the Massachusetts Institute of Technology, and the American Meteorological Society. The Seventh Weather Radar Conference is tentatively scheduled to be held during November 1958, at Miami, Fla.

As noted above, the first conference was relatively informal and resulted in no formal proceedings. The succeeding conferences have each been followed by some form of proceedings recorded and published for limited distribution to the conferees. The proceedings of the fifth and sixth weather radar conferences contain fifty-five papers each.

The American Meteorological Society has created a weather radar committee whose membership has changed from time to time. Probably

the single most important function of this committee has been to arrange for the orderly continuation of these weather radar conferences which have brought together the leading researchers in the field, resulting in a most profitable cross-fertilization of ideas. Rather than discuss at length the contributions made at the various radar conferences, I propose to consider a new development that appears worthy of more detailed notice. This is the application of weather radar to the detection of atomic explosions.

From our discussion above, it can be seen that there exists a network of weather radars in this country capable of providing good coverage for the observation of thunderstorms across most of the United States. Radar Set AN/CPS-9 was developed with the specific purpose of detecting all thunderstorms within 200 miles. Until recently no direct observations were made of a new and more ominous type of atomospheric cloud, namely, that created by an atomic explosion. During recent atomic tests, observations have been made of both kiloton and megaton explosions using Radar Set AN/CPS-9, as well as other radar equipment.

One might expect that a set such as AN/CPS-9, which was designed to detect the aggregate echo from billions of tiny water droplets existing in a natural rainfall, might have fair capacity for the detection of the water droplets, ice crystals, and other particulate matter contained in an atomic cloud. Most of these particles would be sufficiently small – that is, less than approximately one third of the wave length in diameter – for the Raleigh detection to apply. FIGURE 1 shows one such cloud at approximate stabilization time as presented on the range height indicator of the AN/CPS-9. FIGURE 2 shows the echo created by this cloud on the plan position indicator of Radar Set AN/CPS-9.

Although, in some cases, echoes could be detected for a long period of time, it is not clear at this time whether these observations have significance for fall-out prediction or for such purposes as civil defense. It may be suspected that such long persisting echoes consist principally of water substance particles in liquid or solid form that are falling or are possibly supported on updrafts and that may not include the entire volume occupied by contaminated particles. Even if this be so, the radar echoes may be useful for identifying the original bomb location site and in yielding information on such facts as the rate of growth and dimensions of the atomic cloud. Existing radars are not well adapted to tracking radioactive fall-out to the ground. A much more sensitive radar, however, might conceivably have such capabilities.

Much more work remains to be done in the analysis and understanding of the radar observation of atomic clouds. However, this is merely illustrative of the many applications that will continue to be found for weather radar data in their exploitation for the support of life during the latter part of the Twentieth Century.

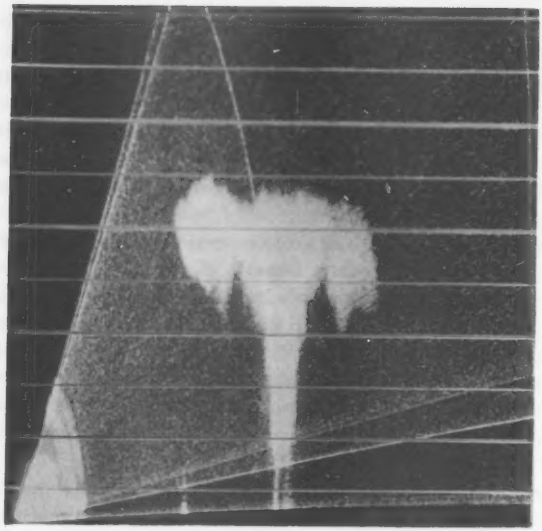

FIGURE 1. Atomic cloud echo on AN/CPS-9 range height indicator.

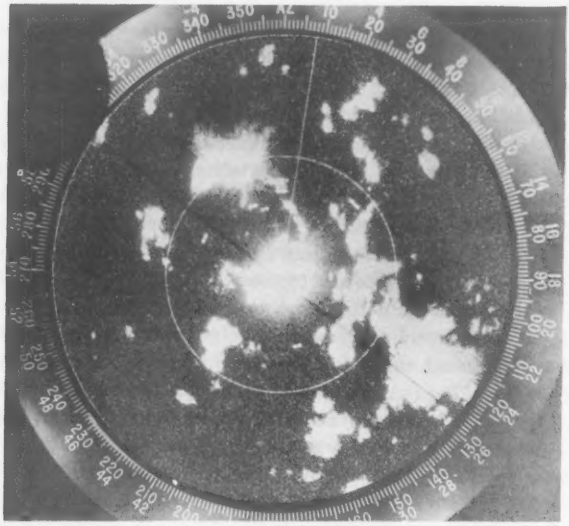

FIGURE 2. Atomic cloud on AN/CPS-9 plan position indicator (at 25-mile range ring, azimuth 335°.

CONFERENCE HELD

SECTION OF BIOLOGY

PHOTORECEPTION

Friday, January 31, and
Saturday, February 1, 1958

Conference Chairman: Jerome J. Wolken
Eye and Ear Hospital and School of Medicine,
University of Pittsburgh, Pittsburgh, Pa.

FRIDAY, JANUARY 31, 1958

PHOTORECEPTOR STRUCTURES

Session Chairman: Warren McCulloch
Massachusetts Institute of Technology, Cambridge, Mass.

9:00 A.M. –
Greetings from the Academy – A. S. Gordon, Chairman, Section of Biology, The New York Academy of Sciences, New York, N.Y.; New York University, New York, N.Y.

Introduction to the Conference – Warren McCulloch, Massachusetts Institute of Technology, Cambridge, Mass.

"Studies of Photoreceptor Structures" – Jerome J. Wolken, Eye and Ear Hospital and School of Medicine, University of Pittsburgh, Pittsburgh, Pa.

"Histochemical Studies on Photoreceptor Cells" – Richard L. Sidman, National Institutes of Health, Public Health Service, Bethesda, Md.

"Biochemistry and Electrophysiology of Insect Vision" – Timothy H. Goldsmith, Harvard University, Cambridge, Mass.

"The Electrical Activity of a Primitive Photoreceptor" – Donald Kennedy, Syracuse University, Syracuse, N.Y.

"Optics of the Insect Eye" – H. de Vries, University of Groningen, Groningen, The Netherlands.

VISUAL PIGMENT PHOTOCHEMISTRY

Session Chairman: George Wald
Harvard University, Cambridge, Mass.

2:00 P.M.–
"The Natural History of Visual Pigments" – Frederick Crescitelli, University of California at Los Angeles, Los Angeles, Calif.

"Biochemistry of Night Blindness"–John Dowling and George Wald, Harvard University, Cambridge, Mass.

"Mechanism of Bleaching Rhodopsin" – Ruth Hubbard and A. Kropf, Harvard University, Cambridge, Mass.

"Visual Pigments and Environment" – H. J. A. Dartnall, Institute of Ophthalmology, University of London, London, England.

"The Kinetics of Cone Pigments Measured Objectively Upon the Living Human Fovea" – W. A. H. Rushton, Cambridge University, Cambridge, England.

"The Behavior of Photoexcited Rhodopsin in Solution" – V. J. Wulff, H. Linschitz, and R. G. Adams, Syracuse University, Syracuse, N. Y.

SATURDAY, FEBRUARY 1, 1958

ELECTROPHYSIOLOGY

Session Chairman: H. K. Hartline
The Rockefeller Institute for Medical Research
New York, N. Y.

9:00 A.M.–
"Neural Interaction in the Eye and the Integration of Receptor Activity" – H. K. Hartline, F. Ratliff, and W. H. Miller, The Rockefeller Institute for Medical Research, New York, N. Y.

"Invertebrate Photoreceptors" – W. H. Miller, The Rockefeller Institute for Medical Research, New York, N. Y.

"Problems in Visual Cell Physiology" – Werner K. Noell, Roswell Park Memorial Institute, Buffalo, N. Y.

"Mechanisms for Chromatic and Achromatic Vision"–G. Svaetichin, Institute of Venezuela, Caracas, Venezuela.

"Human Retinal Responses" – Lorrin A. Riggs, Brown University, Providence, R. I.

"Analysis of Receptive Fields in the Cat's Retina" – Torsten Weisel, Wilmer Institute, Johns Hopkins School of Medicine, Baltimore, Md.

"What Is Behind the Eye" – Warren McCulloch, Massachusetts Institute of Technology, Cambridge, Mass.

Session Chairman: H. J. A. Dartnall
Institute of Ophthalmology, University of London
London, England

2:00 P.M. –
"Some Aspects of the Absolute Sensitivity of the Eye" – M. H. Pirenne, Oxford University, Oxford, England.

"Centifugal Effects on the Amplitude of the Electroretinogram" – J. H. Jacobson, New York Eye and Ear Infirmary, New York. N. Y.

"Models of the Visual Process" – Gerald Oster, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

"Energy Transfer in Ordered and Unordered Photochemical Systems" – Melvin Calvin, G. Tollin, and P. B. Sogo, University of California, Berkeley, Calif.

Review: George Wald, Harvard University, Cambridge, Mass.

Discussion and Summary

Conference Speakers

Closing Remarks: Jerome J. Wolken, Eye and Ear Hospital and School of Medicine, University of Pittsburgh, Pittsburgh, Pa.

NEW MEMBERS

Elected January 23, 1958

LIFE MEMBERSHIP

Sprague, Gale, Ph.D., Electromagnetic Theory. Assistant Director, Cornell University, Ithaca, N. Y.

SUSTAINING MEMBERSHIP

Fortner, Joseph G., M.D. Cancer Research. Clinical Assistant Attending Surgeon, Memorial Hospital, New York, N. Y.

Rappaport, Albert Ivor, Chemistry. President, All-American Chemical Company, Inc., Jackson Heights, N. Y.

Ray, Louis, M.D., Internal Medicine, Brooklyn, N. Y.

Stutz, Hans-Jurg A., M.D., Foreign Clinical Research. Assistant Director, American Cyanamid Company, Pearl River, N. Y.

ACTIVE MEMBERSHIP

Abrahamson, Seymour, Ph.D., Radiation Genetics. Instructor, Rutgers University, New Brunswick, N. J.

Achelis, Johann Daniel, M.D., Pharmacology. Medical Director, C. F. Boehringer & Soehne, Mannheim, Germany.

Allam, Mark Whittier, V.M.D., Veterinary Surgery. Professor, University of Pennsylvania, Philadelphia, Pa.

Allen, Anna Margaret, M.D., Histopathology. Histologist, Department of Agriculture Research Center, Beltsville, Md.

Aloise, Leonard P., Ph.G., Pharmacology. Burroughs-Welcome & Company, Tuckahoe, N. Y.

Altschuler, Henry, Bacteriology. Philadelphia College of Pharmacology, Philadelphia, Pa.

Ambrose, Charles Tesch, M.D., Infectious Diseases. Resident in Medicine, New England Medical Center, Boston, Mass.

Avampato, James E., M.S., Virology. Biologist, Nanuet, N. Y.

Axelrod, D. Robert, M.D., Medicine. Chief, Brooklyn Veterans Administration Hospital, Brooklyn, N. Y.

Baldwin, Robert L., B.S., Bacteriology. Graduate Student, University of Illinois, Chicago, Ill.

Basu, Ajay K., M.S., Chemistry. Chemist, Seton Hall, Orange, N. J.

Battista, Arthur, M.D., Neurosurgery. Instructor, New York University Post Graduate Medical School, New York, N. Y.

Behrendt, Vera Mather, M.D., Psychiatry. Assistant Superintendent, State Hospital, Howard, R. I.

Benison, Joseph, M.D., Dermatology. Staff Dermatologist, Henry Ford Hospital, Detroit, Mich.

Bloomer, Herbert Allan, M.D., Metabolic Diseases. Fellow in Endocrinology, Georgetown University Hospital, Washington, D. C.

Boring, William David, Ph.D., Virology. Assistant Professor, Medical College of Georgia, Augusta, Ga.

Brookman, Barbara, B.A., Psychology. Assistant, Experimental Psychology, Midway Farms, Cranbury, N. J.

Broome, F. K., Ph.D., Organic and Physical Chemistry. Coordinator for Technical Information, Armour & Company, Chicago, Ill.

Brown, Albert B., M.D., Placenta. Professor, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

Brown, Audrey K., M.D., Pediatrics. Research Associate, Wayne University, Detroit, Mich.

Brown, Bernard Beau, Ph. D., Organic Chemistry. Manager, Chemical Research, Olin Mathieson Chemical Corporation, New Haven, Conn.

Brownell, Iverson O., M.D., Psychiatry. Private Practice, Greenville, S. C.
Bryans, Frederick Edward, M.D., Medicine. Assistant Professor, University of British Columbia, Vancouver, Canada.
Bueker, Elmer D., Ph.D., Anatomy. Associate Professor, New York University, New York, N. Y.
Camelio, Albert P., M.D., Medicine. General Practice, Boston, Mass.
Candler, Marguerite Louisa, M.D., Experimental Hematology. Surgeon, U.S. Public Health Service, Atlanta, Ga.
Chien, Shu, Ph.D., Physiology. Instructor, Columbia University, New York, N. Y.
Christenson, William N., M.D., Hematology. Instructor, Medicine, Cornell University Medical College, New York, N. Y.
Cogswell, George W., Ph.D., Organic Chemistry. Research Fellow, Cornell University Medical College, New York, N. Y.
Corwin, Laurence M., Ph.D., Biochemistry. Chemist, National Institutes of Health, Bethesda, Md.
Crannell, Melvin Y., B.S., Pharmaceutical Chemistry. Chief Control Chemist, Chemway Corporation, Wayne, N. J.
Davis, Eldon Vernon, Ph.D., Research Associate, University of Pennsylvania, Philadelphia, Pa.
DeCecio, Thomas C., M.D., Medicine. Fellow, Private Practice, Cliffside Park, N. J.
De Leonibus, Pasquale S., M.S., Oceanography. Physical Oceanographer, U.S. Navy Hydrographic Office, Washington, D. C.
Deneau, Gerald A., Ph.D., Pharmacology. Instructor, University of Michigan, Ann Arbor, Mich.
Devlin, Thomas McKeown, Ph.D., Biochemistry. Research Associate, Merck Institute for Therapeutic Research, Rahway, N. J.
Di George, Angelo M., M.D., Pediatric Endocrinology. Associate in Pediatrics. St. Christopher's Hospital, Philadelphia, Pa.
Doeg, Kenneth Albert, Ph.D., Zoology. Postdoctoral Fellow, Rutgers University, New Brunswick, N. J.
Doyle, John E., M.D., Renal Disease. Research Associate, Medical Foundation of Buffalo, Buffalo, N. Y.
Draper, Laurence R., Ph.D., Microbiology. Resident Research Associate, Argonne National Laboratory, Lemont, Ill.
Dryer, Robert Leonard, Ph.D., Biochemistry of the Lipids. Associate Professor, Biochemistry, State University of Iowa, Iowa City, Iowa.
Dukes, Charles Dean, Ph.D., Immunology. Associate Professor, Microbiology, Baylor University College of Medicine, Houston, Texas.
Du Vries, Henry L., M.D., Disabilities of the Foot. Chicago, Ill.
Eadie, George Sharp, Ph.D., Physiology. Professor, Duke Hospital, Durham, N. C.
Edgcomb, John H., M.D., Pathologic Anatomy. Pathologist, National Cancer Institute, National Institutes of Health, Bethesda, Md.
Eells, Richard S. F., A.B., Policy Sciences. Staff Member in Charge, General Electric Company, New York, N. Y.
Egan, Richard, Ph.D., Physical Biochemistry of Protein. Senior Biochemist, Armour & Company, Chicago, Ill.
Entin, Martin A., M.D., General Surgery. Clinical Assistant, Royal Victoria Hospital, Montreal, Canada.
Fabrikant, Jacob I., M.D., Radiology. Fellow in Surgery, Duke Hospital, Durham, N. C.
Felix, Augusto Jose, M.D., General Surgery. Resident, The Harlem Hospital, New York, N. Y.
Finck, Henry, Ph.D., Cytochemistry. Instructor, Anatomy, University of Pennsylvania, Philadelphia, Pa.
Fogh, Jørgen, M.D., Virology. Assistant Research Virologist, University of California, Berkeley, Calif.
Forchielli, Enrico, Ph.D., Steroid Biochemistry. Research Associate, Worcester Foundation for Experimental Biology. Shrewsbury, Mass.
Forrest, Fred M., M.D., Psychiatry. Chief, Veterans Administration Hospital, Brockton, Mass.
Fox, Howard A., B.S., Endocrinology. Graduate Assistant, Columbia University, New York, N. Y.

Frederik, Willem S., M.D., Industrial Physiology. Director, Research, Liberty Mutual Research Center, Hopkinton, Mass.

Freed, Meier E., M.S., Medicinal Chemistry. Research Chemist, Wyeth Laboratories, Radnor, Pa.

Fridhandler, Louis, Ph.D., Biochemistry. Staff Biochemist, Worcester Foundation for Experimental Biology, Shrewsbury, Mass.

Fujimoto, James M., Ph.D., Pharmacology. Instructor, Tulane University School of Medicine, New Orleans, La.

Gans, Joseph H., Ph.D., Pharmacology. Professor, New York State Veterinary College, Cornell University, Ithaca, N. Y.

Games, Arthur L., M.D., Surgery. Associate Visiting Surgeon, The Harlem Hospital, New York, N. Y.

Garrison, James A., Ph.D., Medicinal Chemistry. Associate Senior Chemist, Evansville, Md.

Geller, Irving, Ph.D., Psychopharmacology. Research Scientist, Wyeth Institute for Medical Research, Philadelphia, Pa.

Gergely, John, Ph.D., Muscle Biochemistry. Associate Biochemist, Massachusetts General Hospital, Boston, Mass.

Glauser, Elinor M., M.D., Medicine. Intern, The Woman's Medical College Hospital of Pennsylvania, Philadelphia, Pa.

Gollub, Seymour S., Ph.D., Hematology. Research Associate, Hahnemann Hospital, Philadelphia, Pa.

Goodner, Charles J., M.D., Medicine. Fellow, Harvard University Medical School, Cambridge, Mass.

Gorzynski, Eugene A., M.A., Enteric Bacteriology. Associate Research Bacteriologist, Children's Hospital, Buffalo, N. Y.

Gossette, Robert L., M.A., Behavior Theory. Instructor, Psychology, Hofstra College, Hempstead, N. Y.

Grace, James Thomas, Jr., M.D., Cancer Immunology. Associate Chief, Roswell Park Memorial Institute, Buffalo, N. Y.

Grebner, Eugene E., B.A., Bacteriology. Graduate Student, University of Pittsburgh, Pittsburgh, Pa.

Greenbaum, David S., M.D., Internal Medicine. Research Fellow, Hunterdon Medical Center, Flemington, N. J.

Hagen, Corrie G., B.A., Physiology. Biologist, American Cyanamid Company, Pearl River, N. Y.

Hahon, Nicholas, Sc.M., Virology. Chief, Virus Section, Chemical Corporation, Frederick, Md.

Hawley, William D., Jr., M.D., Internal Medicine. Resident, Harlan Memorial Hospital, Harlan, Ky.

Hayes, E. Russell, Ph.D., Anatomy. Associate Professor, University of Buffalo, Buffalo, N. Y.

Hayner, Norman S., M.D., Internal Medicine. Staff Epidemiologist, U.S. Public Health Service, Seattle, Wash.

Henigst, Wolf W., M.D., Virology. Instructor, Tulane University Medical School, New Orleans, La.

Herranen, Ailene, Ph.D., Biochemistry. Scientist, Worcester Foundation for Experimental Biology, Chicago, Ill.

Heyman, Jack J., M.S., Biochemistry. Research Scientist, Research Division, Central Islip, N. Y.

Hiers, George O., Metallurgy. Consulting Metallurgist, Retired, Baldwin, N. Y.

Hogness, David S., Ph.D., Biology. Assistant Professor, Washington University, St. Louis, Mo.

Hokama, Yoshitsugi, Ph.D., Microbiology. Junior Research Microbiologist, University of California, Los Angeles, Calif.

Holliday, Malcolm A., M.D., Pediatrics. Assistant Professor, University of Pittsburgh Medical School, Pittsburgh, Pa.

Horoschak, Steven, B.S., Biology. Associate Director, National Drug Company, Philadelphia, Pa.

Iezzoni, Domenic Gabriel, M.D., Clinical Research. Physician, Chas. Pfizer & Company, Brooklyn, N. Y.

Jakoby, Ruth E., M.D., Neurosurgery. Assistant, Neurosurgery, George Washington University Hospital, Washington, D. C.

Jensen, Elroy C., D.V.M., Skin Grafting in the Dog. Assistant Professor, Iowa State College, Ames, Iowa.

Jimenez, Fidelio A., M.D., Pathology. Research Fellow, Pathology, Bronx Hospital, Bronx, N. Y.

Joel, Cliffe David, M.A., Biochemistry. Graduate Student, Harvard University Medical School, Boston, Mass.

Kaiser, Armin Dale, Ph.D., Microbial Genetics. Instructor, Washington University Medical School, St. Louis, Mo.

Kanof, Norman Balfour, M.D., Medicine. Associate Professor, New York University-Bellevue Medical Center, New York, N. Y.

Kaplan, Melvin H., M.D., Rheumatic Disease. Established Investigator, Cleveland City Hospital, Cleveland, Ohio.

Kaslow, Haven D., B.S., Biophysical Chemistry. Research Chemist, General Mills Central Research Laboratory, Minneapolis, Minn.

Kearney, Dora Evelyn, M.A., Mathematics. Instructor, University of Maryland, College Park, Md.

Keith, Eaden F., Ph.D., Pharmacology. Pharmacologist, Roche Laboratories, Hoffmann La Roche, Inc., Nutley, N. J.

Kelleher, Roger T., Ph.D., Psychology. Senior Psychologist, Smith, Kline & French Laboratories, Philadelphia, Pa.

Kellermeyer, Robert W., M.D., Hematology. Research Associate, The University of Chicago, Chicago, Ill.

Kelly, James Hamilton, Ph.D., Pathology. Assistant Director, City of Kingston Laboratory, Kingston, N. Y.

Kelly John Vincent, M.D., Uterine Motility. Instructor, University of California Medical Center, Los Angeles, Calif.

Kelly, William D., Ph.D., Cardiovascular Surgery. Director, Veterans Administration Hospital, Minneapolis, Minn.

Kennedy, Janet Alterman, M.D., Psychoanalysis. Assistant Clinical Professor, Psychiatry, Albert Einstein College of Medicine, Bronx, N. Y.

Kephart, S. Bruce, M.D., Obstetrics. Obstetrician, Caylor-Nickel Clinic, Bluffton, Ind.

Kidwell, Allyn Perry, M.D., Medicine. Clinical Fellow, Columbia University College of Physicians & Surgeons, New York, N. Y.

Kinney, John M., M.D., Surgery. Instructor, Surgery, Harvard University Medical School, Boston, Mass.

Kramer, Edward Ralph, B.S., Biochemistry. Biochemist, Bioclinical Research Laboratories, Great Notch, N. J.

Kreps, Sidney I., M.D., Internal Medicine. Practicing Physician, New York, N. Y.

Kulka, Eugene R., E.E., Electronic Engineering. President, Kulka Electric Corporation, Mt. Vernon, N. Y.

Landa, Joseph S., D.D.S., Masticatory Mechanism. Professor, Prosthodontics, New York University College of Dentistry, New York, N. Y.

Laughlin, John S., Ph.D., Radiation Biophysics. Chief, Biophysics Division, Sloan-Kettering Institute, New York, N. Y.

Lehrer, Gerard M., M.D., Neurochemistry. Resident Neurologist, The Mount Sinai Hospital, New York, N. Y.

Levine, Robert Paul, Ph.D., Genetics. Assistant Professor, Biology, Harvard University, Cambridge, Mass.

Lewis, L. James, Ph.D., Medical Research. Director, Virus Research, The National Drug Company, Philadelphia, Pa.

Lin, Tien-Hui, Ph.D., Biochemistry. Senior Research Scientist, Smith, Kline & French Laboratories, Philadelphia, Pa.

Lipsky, Sanford, Ph.D., Radiation Chemistry. Assistant Professor, Physical Chemistry, New York University, New York, N. Y.

Lobalbo, Charles F., Ph.G., Mycology. Technical Representative, Philip A. Hunt Company, New York, N. Y.

Lowenberg, Miriam E., Ph.D., Psychology. College of Home Economics, Pennsylvania State University, University Park, Pa.

Lum, Gertrude Sheva, Ph.D., Virology. Research Immunologist, May Institute for Medical Research, Cincinnati, Ohio.

Lundstrom, Frank O., M.S., Plant Food Chemistry. Associate Chemist, U.S. Department of Agriculture, Bethesda, Md.

Mann, Jay Donald, Ph.D., Biochemistry. Assistant Scientist, National Institute of Mental Health, Bethesda, Md.

Martin, John H. E., B.S., Chemistry. Research Chemist, American Cyanamid Company, Pearl River, N. Y.

Matthews, Donald C., Ph.D., Experimental Zoology. Professor, University of Hawaii, Honolulu, Hawaii.

Maynard, Donald M., Ph.D., Comparative Neurophysiology. Instructor, Zoology, University of Michigan, Ann Arbor, Mich.

McCombs, Clarence L., Ph.D., Chemistry. Assistant Professor, North Carolina State College, Raleigh, N. C.

Meade, Richard H., III, M.D., Infectious Disease. Acting Chief, Massachusetts Memorial Hospital, Boston, Mass.

Meléndez, Luis Vargos, D.V.M., Virology. Tissue Culture Virologist, Instituto Bacteriológico de Chile, Santiago, Chile.

Millar, Florence Kate, Ph.D., Physiology. Biologist, National Institutes of Health, Bethesda, Md.

Moreton, John R., M.D., Lipid Metabolism. Associate in Medicine, Peter Bent Brigham Hospital, Boston, Mass.

Murphy, Janet E., B.S., Biochemistry. Research Assistant, Pfizer Therapeutic Institute, Maywood, N. J.

Murphy, John R., M.D., Energy Metabolism. Instructor, Western Reserve University, Cleveland, Ohio.

Myers, Robert F. M., M.D., Pediatrics. Practicing Physician, Brandon, Canada.

Nathan, David G., M.D., Neoplastic Diseases. Clinical Associate, National Cancer Institute, Bethesda, Md.

Natoli, Joseph G., M.S., Organic Synthesis. Organic Chemist, West New York, N. J.

Nelson, Marjorie, Ph.D., Nutrition. Associate Research Biochemist, University of California, Berkeley, Calif.

Nelson, Rita P., B.S., Bacteriology. Graduate Student, University of Illinois, Chicago, Ill.

Newburger, Howard Martin, Ph.D., Psychology. Psychologist, New York University, New York, N. Y.

Ogborn, Richard E., M.D., Pediatrics. Chief, Radioisotope Service, Veterans Administration Hospital, Omaha, Nebr.

Osterrieth, Paul M., M.D., Microbiology. Laboratoire Medical De Stanleyville, Belgian Congo, Africa.

Paino, Anthony Francis, B.S., Diuretics. Biologist, American Cyanamid Company, Pearl River, N. Y.

Patterson, Earl S., M.D., Psychiatry. Chief, Insulin Service, Connecticut State Hospital, Middletown, Conn.

Penefsky, Zia J., B.S., Physiology. Graduate Student, New York State University, Brooklyn, N. Y.

Péron, Fernand G., Ph.D., Steroid Biochemistry. Research Chemist, Worcester Foundation for Experimental Biology, Shrewsbury, Mass.

Perryman, James H., Ph.D., Neurophysiology. Assistant Professor, New York University, New York, N. Y.

Rabiner, Saul Frederick, M.D., Hematology. Fellow, The New York Hospital-Cornell Medical Center, New York, N. Y.

Rabinowitz, Yale, M.D., Immunohematology. Assistant Chief, Laboratory Service, U.S. Veterans Hospital, Brooklyn, N. Y.

Ratschow, Max, M.D., Medicine. Director, Der Medizinischen Klinik, Darmstadt, Germany.

Raymond, Detlev, J., B.S., Dissemination of Scientific Information. Executive Secretary, Pergamon Institute, New York, N. Y.

Rebhun, Lionel I., Ph.D., Cytology. Assistant Professor, College of Medicine, University of Illinois, Chicago, Ill.

Reynolds, Luther W., Jr., B.S., Biochemistry. Research Biochemist, Smith, Kline & French Laboratories, Philadelphia, Pa.

Richter, Conrad L., M.D., Industrial Medicine. Medical Director, The Martin Company, Baltimore, Md.

Ringold, Howard J., Ph.D., Synthesis of Steroidal Hormones. Director, Research, Syntex S. A., Mexico, D.F., Mexico.

Rosen, Harry, Ph.D., Pharmacology. Senior Research Scientist, Wyeth Institute for Medical Research, Radnor, Pa.

Rosen, Nathan, Sc.D., Physics. Professor, Israel Institute of Technology, Haifa, Israel.

Rosenblatt, David B., D.Sc., Physics. Research Advisor, Pitman-Dunn Laboratories, Frankford Arsenal, Philadelphia, Pa.

Rosenblüth, Michael A., M.D., Virology. Assistant Resident, Internal Medicine, New York University-Bellevue Hospital, New York, N. Y.

Rosenthal, Isadore, Ph.D., Physical-Analytical Chemistry. Laboratory Head, Rohm & Haas Company, Philadelphia, Pa.

Rutkowski, Gertrude A., M.S., Microbiology. Research Associate, Virology, Merck Institute for Therapeutic Research, Merck Sharp & Dohme, West Point, Pa.

Sabesin, Seymour Marshall, B.S., Internal Medicine. Medical Student, New York University College of Medicine, New York, N. Y.

Salafsky, Bernard, Bacteriology. Philadelphia College of Pharmacology, Philadelphia, Pa.

Samuels, Arthur J., Ph.D., Enzymes. Instructor, Department of Pediatrics, University of Colorado Medical School, Denver, Colo.

Sanders, Fred, Ph.D., Chemistry. Graduate Student, University of Texas Medical Branch, Galveston, Texas.

Sanders, Martin, M.D., Hematology. Clinical Assistant, Mt. Sinai Hospital, New York, N. Y.

Sartorelli, Alan C., M.S., Oncology. Research Assistant, McArdle Memorial Laboratory, Madison, Wis.

Saunders, John W., Jr., Ph.D., Experimental Embryology. Professor, Zoology, Marquette University, Milwaukee, Wis.

Schacht, Lee Eastman, Ph.D., Genetics. Instructor, University of Michigan Medical School, Ann Arbor, Mich.

Schneider, Albert John, Ph.D., Pediatrics. Assistant Chief, Communicable Disease Center, Chamblee, Ga.

Schwartz, Morton A., Ph.D., Steroid Metabolism. Research Fellow, Biophysics, Sloan-Kettering Institute, New York, N. Y.

Seidler, Ben, D.D.S., Endodontics. Private Practice, New York, N. Y.

Seltzer, Samuel, D.D.S., Dental Pathology. Assistant Professor, School of Dentistry, University of Pennsylvania, Philadelphia, Pa.

Seven, Marvin John, M.D., Trace Metals. Associate, Medicine, Hahnemann Medical College and Hospital, Philadelphia, Pa.

Shappirio, David G., Ph.D., Cellular Physiology. Instructor, Zoology, University of Michigan, Ann Arbor, Mich.

Sharkey, William H., Ph.D., Organic Chemistry. Research Supervisor, Wilmington, Del.

Shemano, Irving, Ph.D., Pharmacology. Senior Pharmacologist, Smith, Kline & French Laboratories, Philadelphia, Pa.

Sherk, Henry Huber, M.D., Medicine. Resident, Orthopedic Surgery, Jefferson Hospital, Philadelphia, Pa.

Shigley, Claire Monroe, B.S., Chemical Research. Director, Technical Research, The Dow Chemical Company, Freeport, Texas.

Shulman, Carl, Ph.D., Physics of Solids. Assistant Professor, Engineering, College of the City of New York, New York, N. Y.

Sibley, John Adams, Ph.D., Urology. Urologist, Iowa State College, Ames, Iowa.

Skeggs, Leonard T., Ph.D., Biochemistry. Research Chemist, Veterans Administration Hospital, Cleveland, Ohio.

Smith, Donald M., Ph.D., Polymer Science. Manager, General Research Section, E. I. du Pont de Nemours and Company, Wilmington, Del.

Smith, Edward C., M.D., Medicine. Supervisor, Applied Research, Warner-Chilcott Laboratories, Morris Plains, N. J.

Smith, Laura Lee W., Ph.D., Chemistry of Foods. Assistant Professor, Cornell University, Ithaca, N. Y.

Smith, Ralph Carlisle, M.A., Chemistry. Assistant to President, Nuclear Products-Erco Division, ACF Industries, Riverdale, Md.

Snelgrove, James Arthur, Ph.D., Physical Chemistry. Research Group Leader, West Springfield, Mass.

Speaker, Tully J., M.S., Pharmaceutical Chemistry. Graduate Assistant, University of Connecticut, Storrs, Conn.

Spencer, Herbert L., Ph.D., Medical Research. Executive Vice-President, Samuel H. Kress Foundation, New York, N. Y.

Spitzli, Donald H., M.S., Textiles. Director, Research, The Linen Thread Company, Inc., Paterson, N. J.

Spurr, Robert A., Ph.D., Chemical Physics. Senior Staff Chemist, Hughes Aircraft Company, Culver City, Calif.

Sroog, Cyrus E., Ph.D., Chemistry. Research Supervisor, E. I. du Pont de Nemours and Company, Wilmington, Del.

Stanton, Austin N., M.S., Biology. President, Varo Manufacturing Company, Inc., Garland, Texas.

Stanton, Ralph Gordon, Ph.D., Mathematical Statistics. Chairman, Department of Mathematics, Waterloo College, Waterloo, Ont., Canada.

Starker, Lee N., Ph.D., Organic Chemistry. Research Chemist, Lederle Laboratories, Pearl River, N. Y.

Starkey, Hugh, M.D.C.M., Bacteriology. Director, Laboratories, Queen Mary Veterans Hospital, Montreal, Canada.

Stecker, Herbert Christian, Ph.D., Chemistry. President, Stecker Chemical, Inc., Ridgewood, N. J.

Steele, Harold K., B.C.E., Food Chemistry. Head, The Product Service Division, The Fleischmann Laboratories, Rowayton, Conn.

Stein, Jerome D., Jr., Ph.D., Physiology. Research Associate, Ortho Research Foundation, Raritan, N. J.

Stephens, Edgar R., Chemistry. Senior Research Chemist, The Franklin Institute Laboratories, Philadelphia, Pa.

Stewart, Bruce, Ph.D., Biology. Assistant Professor, Michigan State University, East Lansing, Mich.

Stewart, John Morrow, Ph.D., Biochemistry. Assistant Professor, The Rockefeller Institute, New York, N. Y.

Stiegman, C. A., Ph.D., Research Administration. Technical Director, Hooker Electro-Chemical Company, Niagara Falls, N. Y.

Stiles, A. B., M.S., Industrial Catalysis. Research Associate, E. I. du Pont de Nemours and Company, Charleston, W. Va.

Stiles, Hugh R., Ph.D., Nutrition. Director, Nutrition, National Oats Company, East St. Louis, Ill.

Stolar, Morris E., D.Sc., Pharmacology. Graduate Teaching Assistant, Philadelphia College of Pharmacy and Science, Philadelphia, Pa.

Stone, Gerald, B.E., Engineering. Engineering Scientist, New York University College of Engineering, New York, N. Y.

Stone, Leslie Field, Ph.D., Physics. Technical Superintendent, Toledo, Ohio.

Stovall, Emory J., Jr., B.S., Physics. Staff Member, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

Strain, Franklin, Ph.D., Inorganic and Organic Chemistry. Director, Research, Columbia-Southern Chemical Corporation, Barberton, Ohio.

Straus, Ernst G., Ph.D., Mathematics. Associate Professor, University of California, Los Angeles, Calif.

Streeter, Kermit B., M.S., Microchemistry. Research Associate, Merck Sharp & Dohme Research Laboratories, West Point, Pa.

Strong, Herbert M., Ph.D., High Pressure Physics. Research Associate, General Electric Research Laboratory, Schenectady, N. Y.

Suen, Tzeng Jiueq, Sc.D., Polymers. Group Leader, American Cyanamid Company, Stamford, Conn.

Suess, Hans E., Ph.D., Radio Chemistry. Research Chemist, University of California, La Jolla, Calif.

Suhl, Harry, Ph.D., Theoretical Physics. Research Physicist, Bell Telephone Laboratories, Inc., Madison, N. J.

Sullivan, John W. W., Sc.D., Metallurgy of Iron and Steel. Metallurgical Engineer, American Iron and Steel Institute, New York, N. Y.

Sun, Shiou-Chuan, Sc.D., Flotation. Professor, Pennsylvania State University, University Park, Pa.

Sundberg, Robert Lee, Ph.D., Organic Chemistry. Director, Pharmaceutical Research, Johnson and Johnson, New Brunswick, N. J.

Surgenor, Douglas MacNevin, Ph.D., Biological Chemistry. Assistant Professor, Harvard University Medical School, Boston, Mass.
Sussman, Sidney, Ph.D., Industrial Water Treatment. Chief Chemist, Water Service Laboratories, Inc. New York, N. Y.
Sweeny, William Thomas, M.D., Pathology. Associate Pathologist, St. Joseph Hospital, Burbank, Calif.
Sykes, John Alfred, L.R.C.P., Virology. Research Associate, Clinical Assistant Professor, Microbiology, Baylor University College of Medicine, Houston, Texas.
Taylor, Richard R., M.D., Cardiac Surgery. Director, U.S. Army Research & Development Unit, Fitzsimons Army Hospital, Denver, Colo.
Teeri, Arthur E., Ph.D., Biochemistry. Professor, University of New Hampshire, Durham, N. H.
Theilen, Ernest O., M.D., Cardiovascular Disease. Assistant Professor, University Hospitals, Iowa City, Iowa.
Thommes, Robert Charles, Ph.D., Development. Instructor, Zoology, De Paul University, Chicago, Ill.
Thompson, John Daniel, M.D., Gynecologic Oncology. Assistant Professor, Louisiana State University School of Medicine, New Orleans, La.
Tischler, Stanley H., M.D., Obstetrics. Assistant Attending, Brooklyn Hebrew Home, Brooklyn, N. Y.
Trapani, Ignatius Louis, Ph.D., Environmental Physiology. Research Fellow, California Institute of Technology, Pasadena, Calif.
Tucker, Robert Gene, Ph.D., Nutritional Biochemistry. Group Leader, Smith, Kline and French Laboratories, Philadelphia, Pa.
Tupper, Frederick J., Mineralogy. Geochemist, Vermont Kaolin Corporation, Bristol, Vt.
Vispo, Raul Horacio, M.D., Psychiatry. Assistant Resident, Allan Memorial Institute, Montreal, Canada.
Wagman, Gerald H., M.S., Microbiology. Associate Biochemist, Schering Corporation, Bloomfield, N. J.
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